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ATTACHMENT 30

Guidance on Remedial Actions for Superfund Sites with PCB Contamination
OSWER Directive No. 9355.4-01
August 1990

8/31
p.16

OSWER Directive No. 9355.4-01
August 1990

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GUIDANCE ON REMEDIAL ACTIONS FOR SUPERFUND SITES WITH PCB CONTAMINATION

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

NOTICE

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Executive Summary

This document describes the recommended approach for evaluating and remediating Superfund sites with PCB contamination. It should be used as a guide in the investigation and remedy selection process for PCB-contaminated Superfund sites. This guidance provides preliminary remediation goals for various media that may be contaminated and identifies other considerations important to ensuring protection of human health and the environment. In addition, potential applicable or relevant and appropriate requirements (ARARs) and "to-be-considered" criteria pertinent to Superfund sites with PCB contamination and their integration into the RI/FS and remedy selection process are summarized. This guidance also describes how to develop remedial alternatives for PCB contaminated materials that are consistent with Superfund program expectations and ARARs. The guidance concludes with a discussion of considerations unique to PCBs that should be considered in the nine criteria evaluation and tradeoffs between options that are likely to occur.

Actions taken at Superfund sites must meet the mandates of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as provided for in the National Contingency Plan (NCP). This requires that remedial actions protect human health and the environment, comply with or waive applicable or relevant and appropriate requirements, be cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, there is a preference for remedies that employ treatment that permanently and significantly reduces the mobility, toxicity, or volume of hazardous substances as a principal element. Although the basic Superfund approach to addressing PCB-contaminated sites is consistent with other laws and regulations, this consistency must be documented in the feasibility study and ROD to demonstrate that ARARs have been attained or waived. Primary Federal ARARs for PCBs derive from the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA).

To identify the areas for which a response action should be considered, starting point concentrations (preliminary cleanup goals) for each media are identified. These concentrations represent the level above which unrestricted exposure may result in risks exceeding protective levels. For soils, the preliminary remediation ~~goals should generally~~ be 1 ppm for sites in or expected to be in residential areas. Higher starting point values (10 to 25 ppm) are suggested for sites where non-residential land use is anticipated. Remediation goals for ground water that is potentially drinkable should be the proposed

MCL of .5 ppb. Cleanup levels associated with surface water should account for the potential use of the suface water as drinking water, impacts to aquatic life, and impacts through the food chain.

For contaminated material that is contained and managed in place over the long term, appropriate engineering and institutional controls should be used to ensure protection is maintained over time. An initial framework for determining appropriate long-term management measures is provided.

The Superfund program expectations should be considered in developing appropriate response options for the identified area over which some action must take place. In particular, the expectation that principal threats at the site should be treated, whenever practicable, and that consideration should be given to containment of low-threat material, forms the basis for assembling alternatives. Principal threats will generally include material contaminated at concentrations exceeding 100 ppm for sites in residential areas and concentrations exceeding 500 ppm for sites in industrial areas reflecting concentrations that are 1 to 2 orders of magnitude higher than the preliminary remediation goals. Where concentrations are below 100 ppm, treatment is less likely to be practicable unless the volume of contaminated material is relatively low.

The expectations support consideration of innovative treatment methods where they offer potential for comparable or superior treatment performance or implementability, fewer/lesser adverse impacts, or lower costs. This emphasizes the need to develop a range of treatment options. For PCBs, possible innovative technologies meeting these criteria include solvent extraction, potassium polyethylene glycol dechlorination (KPEG), biological treatment, and in-situ vitrification.

Protective, ARAR-compliant alternatives will be compared relative to the five balancing criteria: long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost. Primary tradeoffs are most likely to occur under the long-term effectiveness and permanence, implementability, and cost criteria.

Final decisions should document the PCB concentrations above which material will be excavated, treatment processes that will be used, action levels that define the area that will be contained, long-term management controls that will be implemented, treatment levels to which the selected remedy will reduce PCB concentrations prior to disposal, and the time frame for implementation.

CONTENTS

TABLES

FIGURES

Number Page

Acknowledgements

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Chapter 1

Introduction

This document describes the recommended approach for evaluating and remediating Superfund sites with PCB contamination. It provides starting point cleanup levels for various media that may become contaminated and identifies other considerations important to ensuring protection of human health and the environment that these cleanup levels may not address. In addition, potential applicable or relevant and appropriate requirements (ARARs) and "to-be-considered" criteria pertinent to Superfund sites with PCB contamination and their integration into the RI/FS and remedy selection process are summarized.

The guidance also describes how to develop remedial alternatives for PCB contaminated materials that are consistent with Superfund program expectations and ARARs. The guidance concludes with a discussion of considerations unique to PCBs that should be considered in the nine criteria evaluation and likely tradeoffs between options that are likely to occur.

1.1 Purpose

This guidance document outlines the RI/FS and selection of remedy process as it specifically applies to the development, evaluation, and selection of remedial actions that address PCB contamination at Superfund sites. The principal objectives of this guidance are to:

- o Present the statutory basis and analytical framework for formulating alternatives designed to address PCB contamination, explaining in particular the regulatory requirements and other criteria that can shape options for remediation;
- o Describe key considerations for developing remediation goals for each contaminated media under various scenarios;
- o Outline options for achieving the remediation goals and the associated ARARs;
- o Summarize the key information that generally should be considered in the detailed analysis of alternatives;
- o Discuss key tradeoffs likely to occur in the remedy selection process;
- o Provide guidelines for documenting remedies for PCB sites in a Proposed Plan and Record of Decision.

Although technical aspects of the investigation, evaluation, and remediation are not discussed in detail, pertinent references and, in some cases, summary information, are provided.

This document is intended for use by EPA remedial project managers (RPMs), State and other Federal Agency site managers responsible for Superfund sites involving PCBs, contractors responsible for conducting the field work and alternatives evaluation at these sites, and others involved in the oversight or implementation of response actions at these sites.

Although each Superfund site may present a unique set of environmental conditions and potential human health problems, general guidelines can be established for sites involving PCBs as the predominant chemical. Utilizing these general principles, site managers can streamline the RI/FS and remedy selection process by conducting a more efficient and effective study. This can be accomplished by: 1) specifying ARARs and other factors that shape the primary options for remediating such sites, 2) identifying key information necessary to fully evaluate those options, and 3) focussing on the major tradeoffs likely to emerge in the comparative analysis upon which remedy selection is based. Consideration of the factors outlined in this document should lead to consistent alternatives development and evaluation at sites involving PCB contamination.

1.2 Background

Approximately 12 percent of the Superfund sites for which Records of Decision (RODs) have been signed (69 of 581 total RODs as of 9/89) address PCB contamination. Preliminary assessment/site inspection data from all sites on the National Priorities List indicates that approximately 17 percent of the sites for which RODs have not yet been signed also involve PCBs. The RI/FS/remedy selection process for PCB sites is complicated for a number of reasons. From a regulatory point of view, there is an unusually high number of potentially applicable or relevant and appropriate requirements (ARARs) and pertinent "to-be-considered" guidelines for actions involving PCB wastes. PCBs are difficult to address technically due to their persistence and high toxicity. Finally, a large number of process options are potentially effective for addressing PCBs and deserve consideration. The approach outlined in this document attempts to address all three aspects of PCB remediation.

1.3 Focus of This Document With Respect to the Remedial Process and Superfund Expectations

The Superfund remedial process begins with the identification of site problems during the preliminary assessment/site inspection, which is conducted before a site is listed on the National Priorities List. The process continues through site characterization, risk assessment, and treatability studies in the RI, the development, screening, and detailed analysis of remedial alternatives in the FS, and culminates in the selection, implementation, and operation of a remedial action. Figure 1-1 shows the steps comprising the Superfund RI/FS process. Arrows indicate key decisions specifically addressed in this document.

The various components of the remedial investigation are not specifically addressed in this document; however, initial reference material including tables outlining properties of PCBs, analytical methods available, and data collection needs/considerations for technologies used to address PCBs are provided. In addition, a general discussion of the assessment of PCB impact on ground water

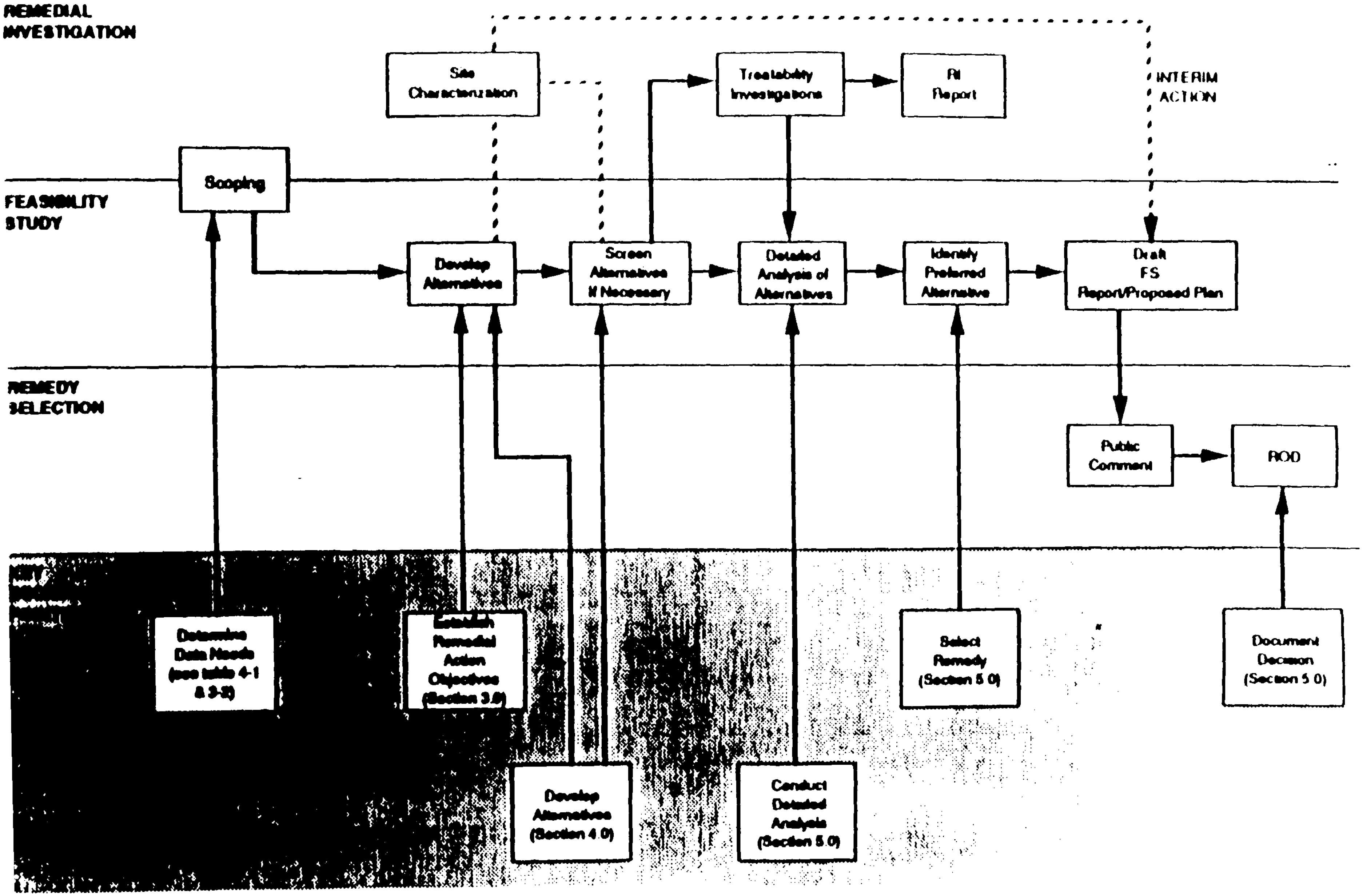

Figure 1-1 DECISION POINTS IN THE SUPERFUND PROCESS

and evironmental considerations which may be pertinent in the risk assessment is provided.

The focus of this guidance is primarily on the feasibility study: development and screening of alternatives, detailed analysis of alternatives, and the consequent selection of remedy. This process is designed to meet the overall Superfund goal to select remedial actions that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. In addition to the overall goal, Superfund actions should consider the following program expectations:

- o Treatment of principal threats wherever practicable,
- o Containment of waste that poses a low long-term threat or where treatment is impracticable,
- o Institutional controls to mitigate short-term impacts or supplement engineering controls,
- o Remedies that combine treatment of principal threats with containment and institutional controls for treatment residuals and untreated waste,
- o Consideration of innovative technologies,
- o Returning contaminated ground water to its beneficial uses within a time frame that is reasonable, where practicable.

The implications of these expectations for PCB contaminated sites is described in appropriate sections of this document.

The development of alternatives involves completing the following steps, considering the program expectations described above:

1. Identify remedial action response objectives including the preliminary remediation goals that define the appropriate concentration of PCBs that could remain at the site without management controls.

2. Identify general response actions such as excavation and treatment, containment, or in-situ treatment. Identify target areas for treatment and containment consistent with Superfund program expectations and consistent with ARARs and TBCs specific to PCB contamination.

3. Identify process options for various response actions. Treatment options for PCBs include incineration,

solvent extraction, KPEG, or other removal/destruction methods. Immobilization techniques may also be considered. Long-term management controls appropriate for the material remaining on site should be noted.

4. Evaluate/screen process options to determine which are technically feasible for the site.

5. Combine feasible process options to formulate alternative remedial actions for detailed analysis.

This document provides general guidance on two primary aspects of the development of alternatives process that are considered and revised throughout the completion of the steps listed above:

- o Determination of the appropriate concentration of PCBs that can remain at a site (remediation goal) under various site use assumptions. This is based on standard exposure and fate assumptions for direct contact. A qualitative consideration of potential migration to ground water and environmental impacts is included for site-specific assessment.

  This concentration will reflect the level that will achieve the program goal of protection and will be achieved through removal and treatment to this level or by restricting exposure to contamination remaining above this level.

- o Identification of options for addressing contaminated material and the implications, in terms of long-term management controls, associated with these options. Remedial actions will fall into three general categories: overall reduction of PCB concentrations at the site (through removal or treatment) such that the site can be used without restrictions, complete containment of the PCBs present at the site with appropriate long-term management controls and access restrictions, and a combination of these options in which high concentrations are reduced through removal or treatment but the levels remaining still warrant some management controls.

  The determination of what combination of treatment and containment is appropriate will be guided by the program expectations to treat the principal threats and contain and manage low-threat material. The determination of what constitutes a principal threat will be site-specific but will generally include material contaminated at concentrations of PCBs that exceed 100 ppm (residential areas) or 500 ppm (industrial areas).

The type of treatment selected will take into account the program expectation to consider innovative treatment. Treatment that is often comparable in performance to but less costly than incineration may be attained using solvent extraction or KPEG. In addition, the potential for adverse affects from incineration can be removed through use of one of these technologies, in-situ vitrification, and in some cases, solidification.

For both evaluations, pertinent ARARs and TBCs are identified.

Finally, this document will: 1) discuss some of the unique factors associated with response actions at PCB-contaminated sites that might be considered under the detailed analysis of alternatives using the evaluation criteria outlined in the proposed NCP, 2) indicate how these factors might be evaluated in selecting the site remedy, and 3) outline the findings that should be documented for the selected remedy.

1.4 Organization of Document

The remainder of this document is divided into four chapters and six appendices, summarized below. At the beginning of each chapter a brief summary highlighting the main points of the section is provided.

Chapter 2 describes the potential ARARs and TBCs most commonly identified for sites involving PCB contamination. This discussion has been separated from the background section because of the complexity of the regulatory framework.

Chapter 3 provides general guidelines for determining PCB concentrations appropriate to leave on site under various scenarios. The primary factors affecting this determination are the medium that is contaminated, the exposure assumptions for the site, and the extent and level of contamination that is to be addressed.

Chapter 4 outlines the remediation options for material which warrants active response. Options include treatment that destroys the PCBs and long-term management controls that prevent exposure to PCBs. The regulatory implications of each option are discussed.

Chapter 5 summarizes the primary considerations associated with determining the appropriate response action for a PCB contaminated Superfund site in terms of the nine evaluation criteria used in the detailed analysis. Key tradeoffs likey to occur among alternatives are noted.

Finally, the findings specific to actions addressing PCBs that should be documented in the Record of Decision are presented.

Appendix A provides a summary of the Superfund sites involving PCBs for which RODs have been signed, including type of response action chosen and clean-up levels specified.

Appendix B provides the detailed calculations supporting the direct contact risk evaluation presented in Chapter 3.

Appendix C provides the backup calculations and methodology for the example evaluation of long term management controls presented in Chapter 4.

Appendix D includes two case studies of Superfund site actions involving PCB contamination: Peppers Steel, FL where the remedy involved solidification and Wide Beach, NY where treatment using the KPEG process was selected.

Appendix E provides a list of the currently permitted PCB disposal companies and their addresses and phone numbers. It also includes a list of EPA's Regional PCB disposal contacts in the TSCA program and their phone numbers.

Appendix F provides examples of long-term management controls implemented at several PCB Superfund sites where varying concentrations of PCBs were left on site.

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
high Electric, PA [02/11/83] [F] cavation and offsite disposal of soils eater than 50 ppm; additional removal soil where cost-effective; demolition buildings onsite; grading and vegetation; O&M.	$6,401,000 Capital Cost	RD: (SCAP) 84/1 RA: (SCAP) 84/4	Not Stated	110,000 ppm	50 ppm	18,800 cubic yards	There are no mobile incinerators permitted to operate in Pennsylvania. Operating costs also would be excessive, making this option not cost effective.
W. Manufacturing, PA [03/31/89] [F] cavation of contaminated waste and soil llowed by offsite incineration at a RA permitted facility; incinerator ash ll be disposed offsite at a RCRA ndfill.	$2,061,000 Capital Cost	RD: (SCAP) 89/4 RA: (SCAP) 90/1	Not Stated	54 ppm	Not Stated	875 cubic yards	Incineration selected
dinance Works Disposal, WV [03/31/88] [FE] site mobile incineration and ntainment of excavated soils and diments, onsite disposal of non EP xic ash residuals in an inactive ndfill, offsite disposal of EP toxic	$6,718,000 Present Worth	RD (SCAP) 91/2 RA (SCAP) 93/4	1016 1260	229 ppm	5 ppm	Not Stated	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
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ash at an approved RCRA facility; close inactive landfill using multi-layer cap.							
Subtotal **							
REGION 04							
Airco Carbide, KY [06/24/88] [RP]							
Excavation and consolidation of contaminated sediments and surface soils in former Burn Pit Area and cap; extraction of ground water and onsite treatment using air stripping, carbon adsorption, and oil/water seperation with discharge of treated water offsite to surface water; deed restrictions; construction of organic vapor recovery system; construction of flood plain protection dike; installation of a leachate extraction system and upgrade existing clay cap.	$6,090,000 Present Worth	RD: (SCAP): 89/3 RA: (SCAP): 91/4	Not Stated	4 ppm (seds)	Not Stated	5,000 cubic yards	Incineration was not retained as a viable alternative through preliminary screening. No rationale was provided in the ROD
Geiger/C&M Oil, SC [06/01/87] [F]							
Excavation and onsite thermal treatment of soil to remove organics followed by	$7,700,000 Present Worth	RD (SCAP) 89/2 RA (SCAP) 91/4	1254	4 ppm	1 ppm	11,300 cubic yards	Incineration selected

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SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
lidification/stabilization of thermally eated soil following treatability udies.							
odrich, B.F. Chemical Group, KY [06/24/88] [RP]							
traction of ground water and treatment ing air stripping, carbon adsorption, d oil/water separation with discharge treated water to surface water; deed strictions; excavation and placement of contaminated surface soils in former n pit area and cap; construction of an ganic vapor recovery system; nstruction of a flood protection dike; tallation of a leachate extraction tem and upgrade existing landfill clay	$6,090,000 Present Worth	RD: (SCAP) 89/3 RA: (SCAP): 91/4	Not Stated	4 ppm (seds)	Not Stated	5,000 cubic yards	Incineration not retained as a viable alternative through preliminary screening. No rationale was provided in the ROD
oray Engineering, AL [09/25/86] [F]							
avation of contaminated soils and her on- or offsite incineration or ite stabilization/solidification of e soils	$750,000 Capital Cost	RD: No RD date, removal action will be conducted to implement ROD; solidification was chosen as the	1260	1,500 ppm	25 ppm	4,800 cubic yards	Incineration preferred in ROD however, Regional Coordinator stated that solidification was selected by the removal program

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AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
		selected action RA: (SCAP): 87/4					
ewport Dump, KY [03/27/88] [FE] **estoration and extention of leachate ollection system; resoration, regrading, nd revegetation of clay cap; monitoring f ground water and soil; O&M.**	$516,000 Capital Cost	RD: (SCAP): 88/1 RA: (SCAP): 88/1	1242 1260	1,020 ppm	Not Applicable	Not Applicable	Incineration was not considered as a remedial alternative in this Record of Decision
ewsom Brothers Old Reichold, MS [09/18/89] [F] **cavation of PCB-contaminated sediments d soils with offsite disposal; cavation of non-PCB contaminated black r-like waste material with offsite eatment using incineration and offsite sposal of ash at a RCRA landfill**	$14,180,249 Present Worth	RD: 90/4 RA: 92/2	1254	10 ppm sediment	0.12 ppm	48,370 cubic yards	Incineration for soils and sediments was not selected due to uncertainty over volume of material to be treated and lack of acceptance by State and community. Higher cost was considered a minor influence in decision
per's Steel & Alloy, FL [03/12/86] [FE] **lidification of PCB contaminated soils h a cement type mixture and onsite**	$5,212,000 Present Worth	RD: (SCAP): 87/1 RA: (SCAP): 89/3	Not Stated	2,700 ppm	1 ppm	40,000 cubic yards	Incineration was not selected due to serious environmental

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AS A CONTAMINANT OF CONCERN

* SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
placement of residuals; residual analysis of solidified soils prior to disposal.							disadvantages (2 16% of lead escapes into the aquifer). inavailability of incinerators, complexity of waste matrix, time intensive remedy, costly, and requires additional waste handling
Smith's Farm Brooks, KY [09/29/89] [F] Excavation of PCB contaminated soil, waste material and sediments from site Area B with onsite incineration followed by solidification/fixation of treatment residuals; capping of soils in Area A; construction of leachate collection system; access restrictions; and ground water monitoring.	$26,900,000 Present Worth	RD: 9?/1 RA: 93/3	1248 1254 1260	6,100 13,100ppm	2 ppm	26,200 cubic yards	Incineration selected
Subtotal **							
REGION 05							
A&F Materials/Greenup, IL [06/14/85] [FE] Excavation and offsite disposal of soil contaminated above recommended action	$824,000 Capital Cost	RD (SCAP) 84/3 RA (SCAP) 85/4	Not Stated	Not Stated	1 ppm	1 332 cubic yards	Incineration was not considered [illegible]

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ITE NAME, STATE (ROD SIGN DATE) (LEAD) OMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
els; decontamination and removal of ite equipment and buildings; ground er monitoring; O&M.							alternative in this Record of Decision
co Anaconda, OH (09/08/89) (RP) avation of 50 cubic yards of sludge h PCB levels >500ppm followed by site incineration and disposal; avation of remaining 3,250 cubic yards sludge and soils (PCB concentrations 0ppm) with offsite disposal in pliance with all RCRA and TSCA ulations; backfilling excavated areas; deed restrictions.	$4,161,066 Capital Cost	RD: 91/3 RA: 93/4	Not Stated	3,000 ppm max sludge	Not Stated	3,300 cubic yards	Incineration selected for PCB concentrations >500ppm
vidare Municipal Landfill #1, IL (06/30/88) (S) ls in the drum disposal area will be ampled and those containing greater n 50 ppm PCBs will either be excavated incinerated offsite or left in place capped with a soil cover; soils taminated with less than 50 ppm PCBs l be consolidated with the landfill erial prior to capping	$5,617,000 Present Worth	RD: (SCAP): 90/1 RA: (SCAP): 92/3	1242 1254 1260	51,000 ppm	50 ppm	Not Stated	Incineration selected for soils containing greater than 50 ppm PCBs

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TE NAME, STATE [ROD SIGN DATE] [LEAD] MPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
w Sand & Gravel, NY [09/30/88] [FE] ation of contaminated soil and ment and onsite consolidation, osal, and capping; collection of ate using either a passive drain m or an active extraction well m and dewatering of contaminated ate and ground water with onsite arge of effluent to surface water or te discharge; multimedia monitoring	$3,727,000- $14,548,900 Present Worth	RD (SCAP) 91/1 RA (SCAP) 93/2	Not Stated	482 ppm	10 ppm	10,000 cubic yards	Thermal treatment (incineration) was not expected to offer significant increases in protectiveness to public health and the environment, or short or long term effectiveness for the increased cost
a, NJ [09/29/87] [FE] ation and offsite landfilling of ontaminated soils; excavation and e biodegradation of PAH-contaminated ; backfilling; grading; and etation.	$1,344,000 Capital Cost	RD (SCAP) 88/4 RA (SCAP) 90/4	1260	37,000 ppm	5 ppm	[illegible],100 cubic yards	Excavation and offsite disposal also may include offsite incineration as a component of the selected remedy
Oil & Chemical, NJ [09/27/85] [F] ation and offsite incineration of hot spots"; removal of tanks, lings, and debris with offsite eration, extraction and offsite eration of aqueous tank contents.	$3,134,683 Total Cost	RD (SCAP) 88/4 RA (SCAP) 90/4	1242 1248 1254 1260	500 ppm	5 ppm	145 cy > 50 ppm 8,650 cy < 50 ppm	Total site contamination not incinerated due to cost

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SITE NAME, STATE (ROD SIGN DATE) (LEAD) COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
fsite disposal of non-aqueous tank ntents; excavation of PCB contaminated il and buried sludge area with offsite sposal.							
de Beach Development, NY (09/30/85) (S) nduct pilot study on KPEG (potassium lyethylene glycol) treatment to termine effectiveness in neutralizing e PCB contaminated soil.	$9,295,000 Present Worth	RD: (SCAP) 89/2 RA (SCAP) 91/1	1254	1,026 ppm	10 ppm	22,300 cubic yards	Incineration not retained as a viable alternative through preliminary screening. No rationale was provided in the ROD
rk Oil, NY (02/09/88) (F) cavation and dewatering of PCB ntaminated soil and sediments with lidification in a mobile onsite unit, e stabilized material will be tested to rify its non-leachability and then sposed onsite; extraction of ground ter with onsite treatment using an oil immer and oil/water separator with scharge into a modular water treatment it, offsite treatment (to be selected lowing treatability studies) of ntaminated tank oils, demolition	$[illegible],500,000 Capital Cost	RD (SCAP) 91/1 RA (SCAP) 93/2	1248 1254 1260	210 ppm	10 ppm (soil) 1 ppb (ground water)	30,000 cubic yards 25,000 gallons	Incineration was not selected because further treatment of the residual ash following thermal destruction may be needed to fuse the high concentration of metals found onsite into the residual ash in a non-hazardous form

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RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
nd decontamination of the empty storage anks.							
ubtotal **							
EGION 03							
alaware Sand & Gravel, DE [04/22/88] [FE]							
ccavation of PCB-contaminated soil at rum Disposal Area and Ridge Area; mporary onsite storage followed by nsite mobile incineration of excavated il and waste; treatability studies; esidual ash will be analyzed and sposed onsite.	$18,250,000 Total Cost	RD: (SCAP): 90/2 RA: (SCAP): 93/4	Not Stated	49 ppm	Not Stated	29,722 cubic yards	Incineration selected
uglassville Disposal, PA [06/24/88] [S]							
moval, transportation, and offsite cineration of liquid and sludge tank ste; decontamination of tanks, piping, ocessing equipment, and building terials designated for salvage or reuse a level not to exceed 100 ug/100 uare centimeters PCBs on the surface. site disposal of building rubble.	$4,050,000 Capital Cost	RD: (SCAP) 89/3 RA: (SCAP) 91/1	1260	6,400 ppm	Not Stated	200,000 gallons	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

TE NAME, STATE (ROD SIGN DATE) (LEAD) MPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
:rete, asphalt, and other materials t cannot be decontaminated to less 1 50 ppm PCBs and treatment watering or incineration) of generated ontamination fluids.							
jlassville Disposal, PA (06/30/89) (S) vation and onsite thermal treatment ontaminated soils, sludges and ments with solidification and onsite posal of ash residuals; installation oil covers in lesser contaminated ce areas; deed restrictions.	$39,280,670-$53,619,000 Capital Cost	RD: (SCAP): 90/3 RA: (SCAP): 91/4	Not Stated	1,889 ppm	Not Stated	48,400 cubic yards	Incineration selected
Chemical, WV (09/29/88) (F) vation and removal of tanks and drums offsite incineration and disposal; nage and onsite treatment of lagoon ge using ion exchange or chemical ation; wastewater treatment using ulated activated carbon with offsite dual discharge to surface water.	$13,130,000 Present Worth	RD (SCAP) 89/2 RA (SCAP) 90/1	Not Stated	Not Stated	Not Stated	Not Stated	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] (LEAD) COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
high Electric, PA [02/11/83] (F) cavation and offsite disposal of soils eater than 50 ppm; additional removal soil where cost-effective; demolition buildings onsite; grading and vegetation; O&M.	$6,401,000 Capital Cost	RD. (SCAP) 84/1 RA. (SCAP) 84/4	Not Stated	110,000 ppm	50 ppm	18,800 cubic yards	There are no mobile incinerators permitted to operate in Pennsylvania. Operating costs also would be excessive, making this option not cost effective.
J. Manufacturing, PA [03/31/89] (F) cavation of contaminated waste and soil llowed by offsite incineration at a RA permitted facility; incinerator ash ll be disposed offsite at a RCRA ndfill.	$2,061,000 Capital Cost	RD. (SCAP) 89/4 RA: (SCAP) 90/1	Not Stated	54 ppm	Not Stated	≈ 875 cubic yards	Incineration selected
Iinance Works D.sposal, WV [03/31/88] (FE) site mobile incineration and ntainment of excavated soils and diments, onsite disposal of non-EP xic ash residuals in an inactive ndfill, offsite disposal of EP toxic	$6,718,000 Present Worth	RD (SCAP) 91/2 RA (SCAP) 93/4	1016 1260	229 ppm	5 ppm	Not Stated	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

* SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
ash at an approved RCRA facility; close inactive landfill using multi-layer cap.							
Subtotal **							
REGION 04							
Airco Carbide, KY [06/24/88] [RP] Excavation and consolidation of contaminated sediments and surface soils in former Burn Pit Area and cap; extraction of ground water and onsite treatment using air stripping, carbon adsorption, and oil/water seperation with discharge of treated water offsite to surface water; deed restrictions; construction of organic vapor recovery system; construction of flood plain protection dike; installation of a leachate extraction system and upgrade existing clay cap.	$6,090,000 Present Worth	RD: (SCAP): 89/3 RA: (SCAP): 91/4	Not Stated	4 ppm (seds)	Not Stated	5,000 cubic yards	Incineration was not retained as a viable alternative through preliminary screening. No rationale was provided in the ROD
Geiger/C&M Oil, SC [06/01/87] [F] Excavation and onsite thermal treatment of soil to remove organics followed by	$7,700,000 Present Worth	RD (SCAP) 89/2 RA (SCAP) 91/4	1254	4 ppm	1 ppm	11,300 cubic yards	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
lidification/stabilization of thermally eated soil following treatability udies.							
odrich, B.F. Chemical Group, KY [06/24/88] [RP]							
traction of ground water and treatment ing air stripping, carbon adsorption, l oil/water separation with discharge treated water to surface water; deed strictions; excavation and placement of contaminated surface soils in former n pit area and cap; construction of an anic vapor recovery system; struction of a flood protection dike; tallation of a leachate extraction tem and upgrade existing landfill clay	$6,090,000 Present Worth	RD: (SCAP) 89/3 RA: (SCAP): 91/4	Not Stated	4 ppm (seds)	Not Stated	5,000 cubic yards	Incineration not retained as a viable alternative through preliminary screening. No rationale was provided in the ROD
oray Engineering, AL [09/25/86] [F]							
vation of contaminated soils and er on- or offsite incineration or te stabilization/solidification of e soils	$750,000 Capital Cost	RD: No RD date, removal action will be conducted to implement ROD; solidification was chosen as the	1260	1,500 ppm	25 ppm	4,800 cubic yards	Incineration preferred in ROD; however, Regional Coordinator stated that solidification was selected by the removal program

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
		selected action RA: (SCAP) 87/4					
ewport Dump, KY [03/27/88] [FE] estoration and extention of leachate ollection system; resoration, regrading, nd revegetation of clay cap; monitoring f ground water and soil; O&M.	$516,000 Capital Cost	RD: (SCAP): 88/1 RA: (SCAP): 88/1	1242 1260	1,020 ppm	Not Applicable	Not Applicable	Incineration was not considered as a remedial alternative in this Record of Decision
wsom Brothers Old Reichold, MS [09/18/89] [F] cavation of PCB-contaminated sediments d soils with offsite disposal; cavation of non-PCB contaminated black r-like waste meterial with offsite eatment using incineration and offsite sposal of ash at a RCRA landfill	$14,180,249 Present Worth	RD: 90/4 RA: 92/2	1254	10 ppm sediment	0 12 ppm	48,370 cubic yards	Incineration for soils and sediments was not selected due to uncertainty over volume of material to be treated and lack of acceptance by State and community. Higher cost was considered a minor influence in decision
per's Steel & Alloy, FL [03/12/86] [FE] idification of PCB contaminated soils h a cement type mixture and onsite	$5,212,000 Present Worth	RD (SCAP) 87/1 RA (SCAP) 89/3	Not Stated	2,700 ppm	1 ppm	48,000 cubic yard	Incineration was not selected due [illegible]

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
placement of residuals; residual analysis of solidified soils prior to disposal.							disadvantages (2 16% of lead escapes into the aquifer), inavailability of incinerators, complexity of waste matrix, time intensive remedy, costly, and requires additional waste handling
mith's Farm Brooks, KY [09/29/89] [F] xcavation of PCB contaminated soil, aste material and sediments from site rea B with onsite incineration followed y solidification/fixation of treatment esiduals; capping of soils in Area A; onstruction of leachate collection ystem; access restrictions; and ground ater monitoring	$26,900,000 Present Worth	RD. 9?/1 RA. 93/3	1248 1254 1260	6,100 13,100ppm	2 ppm	26,200 cubic yards	Incineration selected
ubtotal **							
EGION 05							
AF Materials/Greenup, IL [06/14/85] [FE] xcavation and offsite disposal of soil ontaminated above recommended action	$824,000 Capital Cost	RD (SCAP) 84/3 RA (SCAP) 85/4	Not Stated	Not Stated	1 ppm	1,332 cubic yards	Incineration was not considered [illegible]

ITE NAME, STA E [ROD SIGN DATE] [LEAD] OMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
ils; decontamination and removal of te equipment and buildings; ground r monitoring; O&M.							alternative in this Record of Decision
co Anaconda, IH [09/08/89] [RP] avation of 50 cubic yards of sludge PCB levels >500ppm followed by ite incineration and disposal; avation of remaining 3,250 cubic yards sludge and soils (PCB concentrations)ppm) with offsite disposal in liance with all RCRA and TSCA lations; backfilling excavated areas; deed restrictions.	$4,161,066 Capital Cost	RD: 91/3 RA: 93/4	Not Stated	3,000 ppm max sludge	Not Stated	3,300 cubic yards	Incineration selected for PCB concentrations >500ppm
idere Municipal Landfill #1, IL [06/30/88] [S] ls in the drum disposal area will be mpled and those containing greater 50 ppm PCBs will either be excavated incinerated offsite or left in place capped with a soil cover; soils aminated with less than 50 ppm PCBs be consolidated with the landfill rial prior to capping	$5,617,000 Present Worth	RD: (SCAP): 90/1 RA: (SCAP): 92/3	1242 1254 1260	51,000 ppm	50 ppm	Not Stated	Incineration selected for soils containing greater than 50 ppm PCBs

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
wers Landfill, OH [03/31/89] [RP] pping; management of surface debris; osion control and monitoring of ground ter; O&M.	$4,267,500 Present Worth	RD: (SCAP) 90/4 RA: (SCAP) 92/1	1242 1248 1254	36 ppm	Not Stated	Not Stated	Incineration was not considered as a alternative remedy, and no rationale was provided in the ROD
oss Brothers Pail, IL [09/28/89] [S] sampling of localized PCB soil area to entify existence of PCB source; if entified the source area will be cavated and incinerated offsite at a CA incinerator; installation of a ssive ground water collection and soil ashing system; ground water monitoring, d deed and access restrictions.	$2,076,500 Present Worth	RD: 91/2 RA: 92/4	1242 1248 1254 1260	42,900-112,000 pp	10 ppm	5 cubic yards	Incineration selected
ilds Brook, OH [09/30/86] [F] avation of contaminated sediment with porary storage, dewatering, test burns l onsite thermal treatment followed by ite disposal of ash in a RCRA/TSCA	$12,260,000 Capital Cost	RD (SCAP) 91/3 RA (SCAP) 94/1	Not Stated	518 ppm	50 ppm	16,000 cubic yards	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

ITE NAME, STATE (ROD SIGN DATE) (LEAD) OMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
dfill, unless determined to be hazardous.							
t Wayne Reduction, IN (08/26/88) (F) avation of the western portion of the e for removal of 4,600 buried intact ms and incineration of the drum tents onsite or offsite; nsolidation of excavated soils and es onsite followed by hybrid closure isting of a compacted, continuous cover.	$10,020,000 Present Worth	RD: (SCAP): 91/3 RA: (SCAP): 91/4	Not Stated	14.2 ppm	10 ppm	230,000 gallons	Incineration selected for drum contents; incineration not selected for contaminated soil due to high costs.
lle Electrical Utilities, IL (08/29/86) (F) ation and incineration of aminated soil and clean fill ated areas; decontamination of e structures.	$26,400,000 Present Worth	RD: (SCAP): 87/4 RA: (SCAP): 90/1	1248 1254	5,800 ppm	5 ppm	25,530 cubic yards	Incineration selected
le Electrical Utilities, IL (03/30/88) (F) ation and mobile onsite incineration l contaminated soils and stream	$34,495,180 Present Worth	RD (SCAP) 89/2 RA (SCAP) 93/2	1248 1254	17,000 ppm	5 ppm (surface)	23,500 cubic yards	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

ITE NAME, STATE [ROD SIGN DATE] [LEAD] OMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
lments with subsequent ash analysis to ermine final disposal location; high ssure flushing and mechanical cleaning sewer lines, and collection and atment (to be detailed during design, will include phase separation, tration, and air stripping) of ground er containing PCBs at concentrations ve 1 ppb.					10 ppm (subsoils)		
in/Poplar Oil, OH [08/09/84] [F] vation and offsite incineration of contaminated waste water and oils.	$1,043,000 Total Cost	RD (SCAP) 86/2 RA (SCAP) 92/4	Not Stated	500 ppm	Not Stated	250,000 gallons	Incineration selected
in/Poplar Oil, OH [09/30/87] [F] vation and incineration of oils, pes and highly contaminated soils and ite disposal of ash residuals.	$4,377,500 Present Worth	RD: (SCAP) 89/3 RA: (SCAP) 92/2	1221 1242 1254 1260	144 ppm	6 ppm	71,100 cubic yards	Incineration selected
n/Poplar Oil, OH [06/29/89] [S] al destruction of contaminated	$11,000,000	RD (SCAP) 91/2	Not	Not	Not	5,000	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

NAME, STATE [ROD SIGN DATE] [LEAD] PONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
ash and debris with onsite ial of ash if delisted or offsite ial at a RCRA hazardous waste ll; demolition and thermal ction or decontamination of dioxin inated structures, if these ures cannot be decontaminated then n in a concrete vault onsite and r temporary storage; drain ion and freshwater ponds with rge to surface water and treatment essary; construct a multi-layer cap oils exceeding performance levels; r site by natural ground water flow face water; ground and surface monitoring and land use ctions.	Capital Cost	RA: (SCAP) 92/4	Stated	Stated	Stated	cubic yards	
Disposal, MI [09/30/87] [S] tion and onsite disposal of debris olidification/fixation of soil and extraction of ground water onsite eatment using air strippers or ion ge with discharge to surface water; ction of a slurry wall and cap	$21,743,100 Capital Cost	RD: (SCAP) 90/2 RA: (SCAP) 92/4	Not Stated	Not Stated	Not Stated	136,650 cubic yards	The level of treatment afforded by incineration, while desirable, particularly for PCBs, is not cost effective for the [illegible] site contaminant

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
iami County Incinerator, OH [06/30/89] [F] xcavation and consolidation of ash astes and contaminated soils with isposal in north or south landfill and apping vapor extraction and treatment of xhaust; extraction and treatment unspecified) of ground water with ischarge to POTW; pretreatment of ground ater (unspecified) if necessary; lternate water supply.	$1,700,000- $3,500,000 Present Worth	RD (SCAP): 92/1 RA (SCAP): 92/2	Not Stated	Not Stated	Background levels	22,000 cubic yards	Incineration would cost six to seven times as much as the selected remedy (vapor extraction) without providing a proportionate benefit. Incineration would leave a residue which would need to be disposed of onsite or taken to an appropriate landfill offsite.
Idco I, IN [06/30/89] [RP] xcavation and onsite treatment of 12,400 ubic yards of contaminated soil and aste and 1,200 cubic yards of ontaminated sediments by a combination f vapor extraction and olidification/stabilization followed by nsite disposal; installation and peration of a ground water pumping ystem to intercept contaminated ground ater followed by reinjection into a deep ell, installation of RCRA cap	$9,094,000 Capital Cost	RD: (SCAP) 91/1 RA (SCAP) 93/1	1242 1254 1248	44 ppm	Not Stated	12,400 cy (soil) 1,200 cy (seds)	Incineration is more expensive than the selected alternative and does little to further reduce risk at the site.

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

E NAME, STATE (ROD SIGN DATE) (LEAD) PONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
II, IN (06/30/89) (RP) ation and onsite treatment of 35,000 yards of contaminated soil and , and 500 cubic yards of sediments lidification/stabilization followed site disposal of the solidified installation and operation of a g system tc intercept contaminated l water followed by discharge to a injection well; installation of RCRA	$11,755,400 Capital Cost	RD: (SCAP): 91/1 RA: (SCAP): 93/4	Not Stated	< 50 ppm	Not Stated	35,000 cy (soil) 500 cy (seds)	Incineration is more expensive than the selected alternative and does little to further reduce risk at the site
righton/Arden Hills (TCAAP), MN (08/11/89) (PR) 08/11/89) ROD amends the (06/30/86) / revoking the decision to construct w municipal well #13.		RD: 90/4 RA: 91/2					
Avenue Dump, IN (09/20/88) (F) nment of the oil layer by ucting a soil-bentonite slurry wall ing into the clay layer 30 feet	$1,960,000 Capital Cost	RD (SCAP) 90/3 RA (SCAP) 92/1	1248 1254 1260	1,500 ppm	Not Stated	250,000 200,000 gallons	Incineration not selected because the oil layer is contaminated with chlorinated

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

* SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
below the surface; extraction of oil and ground water within the containment area with treatment of ground water using oil/water separator and discharge into a ground water recharge system; temporary onsite storage of contaminated oil in a secondary containment structure meeting RCRA and TSCA tank storage requirements.							dibenzo dioxins as well as PCBs and it may be difficult to find a commercial incinerator willing to accept dioxin contaminated waste, and a mobile incinerator may not be cost effective.
Ninth Avenue Dump, IN [06/30/89] [F] Excavation of oil contaminated waste, fill, debris, and sediments from on- and offsite surface water followed by onsite thermal destruction in a mobile incinerator; extraction, treatment (unspecified) and reinjection of contaminated ground water inside slurry wall to promote soil flushing; discharge of a small quantity of ground water outside slurry wall to compensate for infiltration; capping.	$22,209,000 Present Worth	RD: (SCAP) 91/3 RA: (SCAP) 93/4	Not Stated	Not Stated	Not Stated	36,000 cubic yards	Incineration selected
Outboard Marine/Johnson, IL [05/15/84] [F] Dredge, dewater and fixate the four contaminated "hot spots" containing PCB	$13,890,000 Capital Cost	RD (SCAP) 85/3 RA (SCAP) 91/4	Not Stated	155,000 ppm	50 ppm	222,400 cubic yards	Fund balancing [illegible] to waive applicable [illegible] incineration

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

E NAME, STATE [ROD SIGN DATE] [LEAD] / MPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
minated soil and sediments with ite disposal. Total amount of PCBs stimated to be 771,200 pounds.							not retained as a viable alternative through preliminary screening
ward Marine/Johnson, MI [03/31/89] [F] ment: Construction of three inment cells to hold contaminated and sediment; excavation of ontaminated sediment and soil with e thermal or chemical extraction, n effective alternative treatment) offsite disposal of extracted PCBs; ment of treated sediment and soil in and capped containment cells; ment of dredge water by sand ation and carbon adsorption with arge to either an offsite sanitary or onsite.	$19,000,000 Present Worth	RD (SCAP) 90/2 RA (SCAP) 91/4	Not Stated	710,000 ppm	> 500 ppm (sediment) > 10,000 ppm (Soil)	Not Stated	There are no PCB extraction or soil treatment technologies specified in this ROD. There is no rationale documented in the ROD concerning which treatment technology will be selected
Township Dump, MI [09/30/87] [S] ation of contaminated soil with e incineration and onsite or offsite ual ash disposal; extraction and ment of contaminated ground water chemical coagulation, air	$32,547,000 Capital Cost	RD (SCAP) 90/3 RA (SCAP) 92/3	Not Stated	980 ppm	10 ppm	50,000 cubic yards	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

TE NAME, STATE [ROD SIGN DATE] [LEAD] MPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
pping, and activated carbon rption with onsite discharge of ted water; O&M.							
alz Dump, WI [08/13/85] [F]							
vation and offsite disposal or ite incineration and offsite residual disposal of contaminated building is.	$2,088,300 Capital Cost	RD: (SCAP): 87/4 RA: (SCAP) 89/1	Not Stated	3,100 ppm	Not Stated	3,500 cubic yards	Incineration is an option for PCB contaminated debris removed from the site
t National Liquid Disposal, OH [06/30/88] [F]							
vation and onsite mobile incineration B contaminated soil, sediment, and s, including tank contents with sal of incinerated residual in an e RCRA landfill; pre-burn tests will quired to demonstrate the type of al destruction to be employed at the	$25,000,000 Present Worth	RD: (SCAP): 90/2 RA: (SCAP): 95/3	Not Stated	Not Stated	Not Stated	32,000 cubic yards 88,000 gallons	Incineration selected
b, IN [06/30/89] [F]							
ing and decontamination of sewer	$24,500	RD (SCAP) 91/2	Not	170 ppm	10 ppm	Not	Incineration for PCB

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

ITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
nes; filtration of sewer water to move PCB contaminated sediments; nitoring of the water and refiltering, necessary with discharge to a POTW; alyze two barrels of sediment and 20 rrels of RI generated waste; > 50 ppm B levels will be treated by offsite cineration and levels < 50 ppm PCB will disposed offsite at a EPA approved te.	Present Worth	RA: (SCAP): 93/3	Stated	(seds)		Stated	concentrations above 50 ppm, offsite TSCA land disposal for concentrations below 50 ppm
btotal **							
GION 06							
anch Limited, TX [03/24/88] [F] -situ biodegradation of sludges and ntaminated soils using indigenous cteria with aeration of the lagoon ite to enhance the degradation process; sidues from the treatment process will stabilized and disposed onsite.	$47,300,000 Present Worth	RD: (SCAP): 90/1 RA: (SCAP): 95/2	Not Stated	616 ppm	23 ppm	149,000 cubic yards	Incineration is more expensive than the selected alternative and does little to further reduce risk at the site
eva Industries, TX [09/18/86] [S] site disposal of surface structures to	$14,992,000	RD: (SCAP): 88/1	Not	1,750 ppm	100 ppm	22,500	The selected remedy offers the

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

ITE NAME, STATE [ROD SIGN DATE] [LEAD] OMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
ardous waste landfill; excavation of ls with > 100 ppm PCBs and drums with site disposal to an EPA-approved ility; construction of a multi-layer y cap and slurry wall; extraction and atment of ground water using carbon orption with discharge to adjacent od control channel.	Capital Cost	RA: (SCAP) 91/3	Stated			cubic yards	same level of protection for public health and the environment. Since onsite incineration was found to generally cost more than offsite remedies, offsite disposal has been selected as the remedy for this site
ey Pit, AR [10/06/86] [FE] truction of an onsite pond water tment unit with discharge to Bayou; val of contaminated solids from pond r and dispose with pit sludge; val of oil from pond water using water separator with treatment using approved incinerator; extraction and ilization of pit sludge with pond ds with onsite disposal; excavation oil and sediments with onsite osal with stabilized material; cap ilized wastes; O&M.	$5,780,000 Capital Cost	RD: (SCAP) 88/4 RA: (SCAP) 91/2	Not Stated	20 ppm	Not Stated	17 cy (oil), 15,984 cy (sludge)	The large increase in cost for incineration for a small gain in containment weighted against incineration of sludge waste. In addition, a large quantity of waste would have to be transported to an incinerator. This would increase the danger of exposure of the public through accidental spills. Offsite incineration was selected for the small quantity of PCB contaminated oil removed from the ponded water

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

E NAME, STATE [ROD SIGN DATE] [LEAD] PONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
ge/Criner, OK [11/14/86] [FE] ction of surface and ground water separation of NAPL followed by te incineration of organic liquids offsite disposal of ash residuals, site incineration with onsite sal of solid ash residuals, and r recycle or treat (unspecified) sal liquids followed by offsite irge; onsite treatment of soils and by one or more of the following: al neutralization, solidification, iring, chemical oxidation/reduction, ripping; rotory-kiln incineration scale test to be conducted for ire content and reactions of luid combinations and if sful, conduct pilot study and ons testing.	$68,000,000 Present Worth	RD: currently negotiating with PRP, (SCAP): 89/1, RA: (SCAP): assuming RP judgement 92/4	1260	> 50 ppm	Not Stated	175,000 cubic yards	Determine soil treatment remedy during remedial design
TX [03/15/85] [F] tion and offsite incineration of quid organics at a permitted TSCA ty, excavation and offsite disposal	$42,300,000 Capital Cost	RD (SCAP) 86/4 RA (SCAP) 94/1	Not Stated	100 ppm	Not Stated	18,000 cubic yards	Incineration selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

TE NAME, STATE (ROD SIGN DATE) (LEAD) MPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
CB-contaminated tars and sludges at a landfill; extraction of pit water treatment at an industrial waste r treatment plant.							
idan Disposa' Services, TX (12/29/88) (RP)							
ation and onsite biotreatment of all es, debris, floating oil and ion, and soils containing > 25 ppm Bs; residuals, reduced to < 50 ppm will be stabilized onsite, returned e pond and capped; if the residuals 50 ppm PCBs, the pond will be a compliant landfill; decontamination disposal of all onsite tanks and ssing equipment with onsite ment (unspecified) or offsite sal depending on contents; treatment orm and waste water streams to e solids, metal and organics with arge to surface water; institutional ols.	$28,346,000 Capital Cost	RD: (SCAP): 91/1 RA: (SCAP): Not Available	Not Stated	223 ppm	25 ppm	44,000 cubic yards	Bioremediation significantly reduces mobility, toxicity and volume and essentially eliminates the source of contamination to the ground water. Incineration is mechanically complex, using highly specialized costly equipment and operators and would have required approved offsite disposal of ash
ynn/Industrial Transformers, TX (03/25/88) (F)							
tion and treatment of contaminated	$2,200,000	RD (SCAP) 90/4	Not	350 ppm	25 ppm	2,400	Incineration not selected

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

TE NAME, STATE (ROD SIGN DATE) (LEAD) MPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
with an alkali metal polyethylene :olate (APEG) reagent in a batch :tor; pretreatment, if necessary, and :harge of liquid by-products of itment to a POTW; APEG feasibility ting will be conducted during the ign phase.	Present Worth	RA :(SCAP) 93/2	Stated			cubic yards	because it is not cost effective and no additional protection would be provided by this treatment
otal **							
ON 07							
ke Disposal Holliday, KS (09/21/89) (RP) val and offsite treatment of aminated liquids ponded under former ace impoundments; construction of an rmeable multi-layer cap over majority aste area, including soils aminated with PCBs; deed and access rictions; and ground water toring.	$5,970,000 Present Worth	RD: 91/1 RA: 93/3	1248 1254 1260	07- 393 ppm	Not Stated	Not Stated	Due to the magnitude of waste and low PCB concentrations further studies will be performed to fully characterize soils. Incineration not considered as alternative for this operable unit.
tal **							

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE [ROD SIGN DATE] [LEAD] COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
;ION 09							
rentz Barrel & Drum, CA [09/28/88] [FE]							
traction of PCB contaminated ground ter and onsite treatment using a :kaged ozone-UV system with discharge treated effluent onsite to a storm ær.	$3,238,000 Present Worth	RD: (SCAP): 90/1 RA: (SCAP): 91/4	1221 1242 1254 1260	6 4 ppm	0 065 ppb	Not Stated	Incineration was not discussed as a treatment alternative in the ROD
4 Brakes, CA [09/29/88] [FE]							
:avation of PCB-contaminated soil with 'site disposal of soil; extraction and ıatment of wastewater from dewatering ocess in a mobile treatment system ıspecified) and discharge of treated ter either onsite or to a POTW; soil ıtaining > 50 ppm PCBs will be ınsported to a Class I TSCA-permitted iposal facility; soil containing 10-50 ı PCBs will be transported to a Class CA DOHS-permitted facility; demolition processing building, crushing of the ıcrete slab and excavation of the lerlying soil contaminated with > 10 ı PCBs followed by transportation and 'site disposal of the contaminated ıcrete in an appropriate disposal	$5,369,300 Present Worth	RD: (SCAP): 90/4 RA: (SCAP): 91/4	Not Stated	4,500 ppm	10 ppm	13,510 cubic yards	Incineration was not selected because of community opposition and limited availability of incinerators

SITE NAME, STATE (ROD SIGN DATE) (LEAD) COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
acility.							
ubtotal **							
EGION 10							
Commencement Bay-Near Shore/Tide Flats, WA (09/30/89) (RP)							
Source remediation involving control of ffluentsources; PCB-contaminated ediment remediation includes natural ttenuation and utilization, as ppropriate, of four alternatives ncluding in-situ capping, confined quatic disposal, confined nearshore isposal, and removal and upland disposal nshore; site use restrictions; and ediment monitoring.	$32,300,000 Total Cost	RD: 93/4 RA: 94/4	Not Stated	Not Stated	1,500 ppm sediment	1,181,000 cubic yards	Most problem areas are characterized by significant metals contamination, which is not mitigated by incineration. Additionally, marine sediments were found to have very low BTU content, making incineration extremely energy intensive and less cost effective considering the volume of contaminated material.
mmencement Bay/NTF, WA (12/30/87) (FE)							
cavation and stabilization of PCB ntaminated soils; extraction and bilization of ponded water and liments with onsite disposal of	$3,400,000 Present Worth	RD: (SCAP) 91/1 RA: (SCAP) 92/1	Not Stated	204 ppm	1 ppm (soil) 2 ppb (ponded	45,000 cubic yards	Incineration not selected as a viable alternative through a preliminary feasibility study [illegible] to high cost

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

SITE NAME, STATE (ROD SIGN DATE) (LEAD) COMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
eatment residuals and asphalt capping the entire stabilized matrix.					water)		
rthwest Transformer, WA (09/15/89) (F) cavation, consolidation and treatment soils with PCB concentrations >10ppm ing in-situ vitrification; well andonment; construction of soil cover; d ground water monitoring.	$771,000 Total Cost	RD: 91/4 RA: 93/2	1260	1-10 ppm	10 ppm	1,200 cubic yards	The best thermal destruction process for this site was determined to be vitrification based on ease of mobilization, lower cost, lack of residuals management and local acceptance of treatment process.
ific Hide & Fur Recycling, ID (06/28/88) (RP) avation of contaminated soil with idification of soils; installation of l cover over solidified soils with her on- or offsite disposal; onsite tainment of contaminated soils if idification found to be not viable ough a pilot study; decontamination of ris with either on- or offsite posal.	$1,890,000 Present Worth	RD (SCAP) 89/4 RA (SCAP) 91/4	Not Stated	Not Stated	25 ppm (restricted) 10 ppm (non-restricted)	8,200 cubic yards	Incineration not selected as a viable alternative through preliminary screening due to difficulty of implementation.

SUMMARY REPORT OF FY82 THROUGH FY89
RECORDS OF DECISION THAT ADDRESS POLYCHLORINATED BIPHENYLS
AS A CONTAMINANT OF CONCERN

ITE NAME, STATE (ROD SIGN DATE) (LEAD) OMPONENTS OF THE SELECTED REMEDY	COSTS	RD/RA COMPLETION DATES	AROCHLORS	PRE-TREATMENT CONCENTRATION	EXCAVATION LEVELS	ESTIMATED VOLUME	RATIONALE WHY INCINERATION WAS NOT SELECTED
en City Farms, WA (10/24/85) (FE) se separation of sludge with idification and liquid stabilization. site disposal of contaminated soil.	$3,439,000 Total Cost	RD: (SCAP) 87/1 RA: (SCAP): 87/1	1260	125 ppm	Not Stated	5,200 cubic yards	Incineration not selected due to cost, limited incinerator capacity and difficulty in transportation
tern Processing/Phase II, WA (09/25/85) (F) duct bench-scale tests using in-situ idification/stabilization; if cessful, conduct pilot studies.	$18,100,000 Present Worth	RD: (SCAP): 88/4 RA: (SCAP): 89/2	Not Stated	1,128 ppm	2 ppm, (Offsite) 50 ppm (Onsite)	10,650 cubic yards	Incineration not retained as a viable alternative through preliminary screening

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APPENDIX B

DIRECT CONTACT RISK CALCULATION

Risk Calculations for an Individual Contacting PCB Contaminated Soil

Risk are calculated below for an individual in contact with PCB contaminated soil at three concentrations, 0.1 ppm, 1 ppm, and 10 ppm. The pathways considered are soil ingestion, dermal contact and inhalation of volatilized PCBs.

Soil Ingestion Scenario

Some of the PCB in the soil is going to volatilize throughout the years. Therefore, if a more in-depth assessment is required, the volatilization of PCB needs to be accounted for. The equations used to account for the volatilization of PCBs from the soil over certain period of time are derived in Appendix A of the EPA document titled Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup (U.S. EPA, 1986a).

Assumptions

Exposure Factor	Value	Reference or Comment
Child Ingestion rate (mg/day)	200	U.S. EPA, 1989f
Adult Ingestion rate (mg/day)	100	U.S. EPA, 1989f
Exposure Duration for a child (yrs)	6	U.S. EPA, 1989f
Exposure Duration for an aduld (yrs)	24	(30 - 6)
Exposure Frequency (days/yr)	365	U.S. EPA, 1989f
Body weight child (kg)	16	U.S. EPA, 1989f
Body weight adult (kg)	70	U.S. EPA, 1989f
Absorption fraction	30%	U.S. EPA 1986a

$$\text{Exposure} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where,
C = concentration of PCB in soil

IR = intake rate

ED = exposure duration

EF = exposure frequency

BW = body weight

AT = averaging time (70 yrs for a carcinogen)

To estimate exposure, the average concentration of PCBs in soil over the exposure period is calculated. The concentration of PCBs will decrease with time due to volatilization. This concentration is estimated using the equation A-35 from the 1986 PCB cleanup guidance for an uncovered surface.

$$C_s = C_{so} \frac{1}{z} \quad \mathrm{erf} \frac{z}{2 \quad t} dz$$

where,

C_s = average concentration of PCB in soil (ppm)

C_{so} = initial concentration of PCB in soil (ppm)

z = depth of contamination (cm)

= constant defined by $\dfrac{D_{ei} \times E}{[E + P_s \times (1 - E) \times K_d/H]}$

t = exposure time divided by 4 (sec)

D_{ei} = effective diffusivity (cm^2/s) = $D_i \times E^{1/3}$

D_i = molecular diffusivity (cm^2/s)

E = pore porosity (unitless)

P_s = bulk density of soil (g/cm^3)

K_d = soil/water partition coefficient (mg/g soil)/(mg/cm^3 water)

H = Henry's Law Constant (atm-m^3/gmol)

Example calculation for the following set of assumptions:

C_{so} = 1 ppm

z = 25.4 cm (10 inches)

D_i = 0.05 cm^2/s

E = 0.35

P_s = 2.65 g/cm^3

K_d = 1000 (mg/g soil)/(mg/cm^3 water)

H = 8.37×10^{-3} (atm-m^3/gmol)

t = 6 yrs/4 = 1.89×10^8 sec/4 = 4.73×10^7 sec

$$C_s = \frac{1}{25.4} \quad \text{erf} \frac{z}{21.53} \quad dz$$

This equation is solved by assuming different values of z and evaluating the error function using the table attached. Then the integral is evaluated numerically using the Trapezoidal Rule.

z (cm)	erf(x)
0	0
5	0.2550
10	0.4847
15	0.6778
20	0.8116
25	0.9103

Using the Trapezoidal Rule:

$$f(x)\ dx = \frac{b - a}{2n} [f(x_0) + 2\ f(x_1) + 2\ f(x_2) + \ldots 2\ f(x_{n-1}) + f(x_n)]$$

$$C_s = \frac{(25.4 - 0)}{(25.4)(2)(5)} [0 + 2(.02550) + 2(0.4847) + 2(0.6778) + 2(0.8116) + 0.9103]$$

C_s = 0.54 ppm

The same procedure is used to determine the average concentration for a period of 30 yrs which yields a concentration of 0.28 ppm for the adult exposure.

Example calculation for soil ingestion by a child at an initial concentration of 1.0 ppm

$$\text{Exposure} = \frac{0.54\ \text{mg}}{\text{kg}} \times \frac{200\ \text{mg}}{\text{day}} \times \frac{365\ \text{days}}{\text{yr}} \times 6\ \text{yrs} \times \frac{1}{16\ \text{kg}} \times \frac{1}{70\ \text{yrs}}$$

$$\times \frac{\text{yr}}{365\ \text{days}} \times \frac{10^{-6}\ \text{kg}}{\text{mg}}$$

$$= 5.8 \times 10^{-7}\ \text{mg/kg-day}$$

Similarly, the adult exposure is estimated.

$$\text{Exposure} = \frac{0.28\ \text{mg}}{\text{kg}} \times \frac{100\ \text{mg}}{\text{day}} \times \frac{365\ \text{days}}{\text{yr}} \times 24\ \text{yrs} \times \frac{1}{70\ \text{kg}} \times \frac{1}{70\ \text{yrs}}$$

$$\times \frac{\text{yr}}{365\ \text{days}} \times \frac{10^{-6}\ \text{kg}}{\text{mg}}$$

$$= 1.4 \times 10^{-7}\ \text{mg/kg-day}$$

The total exposure is calculated by adding the child and the adult exposure.

Total exposure = 7.2×10^{-7} mg/kg-day

Cancer risk is then calculated using a cancer potency factor for PCBs of 7.7 $(\text{mg/kg-day})^{-1}$ and multiplying by an absorption factor of 30%. The table below summarizes the total exposure and risk from soil ingestion (child + adult) for the three concentration values.

Soil Concentration (ppm)	Total Exposure (mg/kg-day)	Risk
0.1	7.2×10^{-8}	2×10^{-7} [B2]
1.0	7.2×10^{-7}	2×10^{-6} [B2]
10	7.2×10^{-6}	2×10^{-5} [B2]

Dermal Contact Scenario

As in the soil ingestion scenario, the concentration of PCB in the soil is needs to be averaged over the period of exposure to account for the volatilization of PCBs. Exposure is estimated for both a child and an adult. A child ages 3 - 18 years old wearing shorts and short sleeve shirt is assumed to be exposed 3 times/week during the spring and fall and 5 times/week during the summer months. The adult is assumed to be wearing long pants and short sleeve shirt while gardening 1 day/wk during spring, fall and summer.

Assumptions

Exposure Factor	Value	Reference
Surface area arms, hands and legs (average 3 -18 yrs) (m^2/event)	0.40	U.S. EPA, 1989f
Surface area arms and hands (adult) m^2	0.31	U.S. EPA, 1989f
Soil to skin adherence factor (mg/cm^2)	2.77	U.S. EPA, 1989f
Exposure frequency (child) (events/yr)	132	U.S. EPA, 1989f
Exposure frequency (adult) (events/yr)	52	judgement
Exposure duration (child) (yr)	15	(18 - 3)
Exposure duration (adult) (yr)	12	(30 - 18)
Body weight (child) (kg)	38	U.S. EPA 1989c
Body weight (adult) (kg)	70	U.S. EPA 1989c
Absorption fraction	10%	U.S. EPA 1988a

$$\text{Exposure} = \frac{C \times SA \times AF \times EF \times ED}{BW \times AT}$$

where,
SA = surface area (cm^2/event)
AF = soil - skin adherence factor

The absorption fraction is based on a study the was conducted by Versar/Mobil to measure the dermal bioavailability of dioxin (TCDD) and trichlorobiphenyl (TCB) sorbed to soil. Results of this study will be incorporated into a draft report titled Dermal Absorption of Dioxins and PCBs from Soil (U.S. EPA, 1988a) which is being revised by Versar for the Office of Toxic Substances. In vitro dermal absorption through human skin resulted in 8% absorption for TCB in low organic content soil (0.77% organic matter) and 10% in high organic content soil (19.35%). It is important to understand the uncertainties associated with these values. These are based on only one experiment and the TCB content in the soil was 1000 ppm.

To estimate the exposure through the dermal route, the average concentration of PCBs in the soil needs to be estimated and volatilization of PCBs accounted for using the same procedure described in the soil ingestion scenario. The average concentration of PCB in the soil after a period of 15 yrs is 0.38 ppm which is used for the child scenario and 0.28 after 30 yrs which is used for the adult scenario.

Dermal exposure is estimated for a child exposed to soil with an initial concentration of 1 ppm of PCBs.

$$\text{Exposure} = \frac{0.38\ \text{mg}}{\text{kg}} \times \frac{.40\ \text{m}^2}{\text{event}} \times \frac{132\ \text{events}}{\text{yr}} \times \frac{2.77\ \text{mg}}{\text{cm}^2} \times 15\ \text{yrs}$$

$$\times \frac{1}{38\ \text{kg}} \times \frac{1}{70\ \text{yrs}} \times \frac{\text{yr}}{365\ \text{days}} \times \frac{10^{-6}\ \text{kg}}{\text{mg}} \times \frac{10^{4}\ \text{cm}^2}{\text{m}^2}$$

$$= 8.6 \times 10^{-6}\ \text{mg/kg-day}$$

In this case, as in the adult calculation event = day. The exposure for an adult is estimated below.

$$\text{Exposure} = \frac{0.28\ \text{mg}}{\text{kg}} \times \frac{0.31\ \text{m}^2}{\text{event}} \times \frac{2.77\ \text{mg}}{\text{cm}^2} \times \frac{52\ \text{events}}{\text{yr}}$$

$$\times 12\ \text{yrs} \times \frac{1}{70\ \text{yrs}} \times \frac{1}{70\ \text{kg}} \times \frac{\text{yr}}{365\ \text{day}} \times \frac{10^{-6}\ \text{kg}}{\text{mg}} \times \frac{10^{4}\ \text{cm}^2}{\text{m}^2}$$

$$= 8.4 \times 10^{-7}\ \text{mg/kg-day}$$

Then risk is estimated by multiplying the total exposure (child + adult) times the cancer potency factor for PCB and multiplying by the absorption factor of 10%. The table below summarizes exposure and risk for the three soil concentrations.

Soil Concentration (ppm)	Total Exposure (mg/kg-day)	Risk
0.1	9.4×10^{-7}	7×10^{-7} [B2]
1.0	9.4×10^{-6}	7×10^{-6} [B2]
10	9.4×10^{-4}	7×10^{-5} [B2]

Vapor Inhalation Scenario

Exposure to volatilized PCB is estimated for an individual standing on site. If risk estimates exceed the cleanup value range of 10^{-4} - 10^{-7}, then off-site air concentrations need to be estimated using dispersion models. In order to use dispersion models, site specific data such as meteorological data are necessary. On site air concentrations are estimated by using a "box model" described in the 1986 PCB guidance document (U.S. EPA, 1986a).

$$C = \frac{Q}{Ls \times V \times H}$$

where,
Q = flux rate (g/sec) Q = Emission rate x Area
Ls = width dimension of contaminated area (m)
V = average wind speed at mixing height (m/s)
H = mixing height (m)
At the mixing height the V = 0.5 x wind speed. A wind speed of 10 mph (4.5 m/s) which is the average in the United states is used. The flux rate is estimated using the model described in the 1986 PCB guidance document (U.S. EPA, 1986a). It is assumed that the contaminated soil is uncovered and the depth of contamination is 25 cm.

Emission rates are tabulated below.

Soil Concentration (ppm)	Emission rates (g/cm^2-s)
0.1	9.9×10^{-15}
1.0	9.9×10^{-14}
10	9.9×10^{-13}

To estimate the concentration in air, a mixing height of 2 m and a width Ls of 45 m are assumed. These are the values assumed in the 1986 PCb guidance document (U.S. EPA, 1986a). Air concentrations are tabulated below.

Soil Concentration (ppm)	Air Concentration (g/m^3)
0.1	9.9×10^{-10}
1.0	9.9×10^{-9}
10	9.9×10^{-8}

Inhalation exposure is estimated for an adult using the assumptions listed below.

Assumptions

Exposure Factor	Value	Reference
Adult Inhalation rate (m^3/day)	30	U.S. EPA, 1989f
Exposure Duration (yrs)	30	U.S. EPA, 1989f
Body weight		

adult (kg)	70	U.S. EPA, 1989f
Absorption fraction	50%	U.S. EPA 1986a

$$\text{Exposure} = \frac{9.9 \times 10^{-10}\ \text{g}}{\text{m}^3} \times \frac{30\ \text{m}^3}{\text{day}} \times \frac{30\ \text{yrs} \times 1 \times 1}{70\ \text{kg} \quad 70\ \text{yrs}} \times \frac{10^3\ \text{mg}}{\text{g}}$$

$$= 1.8 \times 10^{-7}\ \text{mg/kg-day}$$

Exposure and risks are tabulated below for the three concentration values.

Soil Concentration (ppm)	Exposure (mg/kg-day)	Risk
0.1	1.7×10^{-7}	7×10^{-7} [B2]
1.0	1.7×10^{-6}	7×10^{-6} [B2]
10	1.7×10^{-5}	7×10^{-5} [B2]

Uncertainties

Sources of uncertainty include measured values that may not be accurate or representative, use of mathematical models which may not reflect the physical or chemical process actually occurring and assumptions on the selection of parameters in the models.

The analysis conducted used the physical and chemical properties of Aroclor 1254 to estimate air emission rates because this will yield the most conservative estimate. On the other hand, the Agency derived a Cancer Potency Factor for Aroclor 1260, which is the most toxic of the Aroclor, and uses it to be representative of other PCB mixtures. However, emission rate results may not be affected significantly since these two Aroclors have similar physical and chemical properties.

Human behavior patterns can strongly affect exposure results. Based on the limitations of our knowledge, the values for the exposure duration and frequency for the pathways considered are intended to be best reasonable upperbound estimates. For example, the vapor inhalation scenario assumes that a person will be breathing at a 30 m^3/day rate 24 hours/day for a period of 30 years. It also assumes that the concentration indoors will be the same as the concentration outdoors. These assumptions are considered reasonable since it is possible to observe certain subpopulations (i.e., housewife) spending the majority of their time at their residence without air conditioning.

In the soil ingestion scenario, the exposure values obtained do not account for children with pica behavior. Exposure estimates that will reflect this type of behavior will be considerably higher.

The rate of air emission through volatilization was calculated using the model developed in the 1986 PCB guidance (U.S. EPA, 1986a). The model is based on theoretical mass-balance equations to account for fundamental physical/chemical transport processes. No empirical data are available to validate the model. Values of the parameters that are input into the model are based on soil characteristics such as E and Ps, physical laws such as D_i, or determined empirically such as K_d. The latter is one of the major sources of uncertainty. The K_d depends not only on the chemical but also in the soil characteristics (i.e., organic carbon content). A K_d based on highly adsorbable soil was used which will result in a higher emission rate than if a less adsorbable soil such as sandy soils is used.

There are also uncertainties with the values used for absorption factors. For example, the absorbtion factor of 10% used in the dermal exposure scenario is based on very limited data. This assumption was based on one study which used a concentration of tetrachlorobiphenyl of 1000 ppm in the soil. It is likely that the absolute dermal absorption at lower concentrations in the soil will tend to be less.

APPENDIX D

CASE STUDIES

PEPPER STEEL, FL AND WIDE BEACH, NY

soil and the soil cap will prevent PCBs from migrating to the ground water at levels that exceed .5 ppb. With the reduce infiltration the maximum PCB concentration projected for the ground water (occurring after 1645 years) is .3 ppb. Again, a deed notice would be warranted to prevent direct contact with the soil in the future. Consistent with Table 4-2, a fence and some ground water monitoring (annual) would be recommended.

<u>100 ppm PCBs Source</u> At 100 ppm, PCB concentrations in the ground water are projected to exceed the .5 ppb level slightly -- approximately .6 ppb, even with the addition of a low-permeability cover soil. At this concentration, for the site conditions presented, the third cap illustrated in Figure C-1 would be recommended. The addition of a flexible membrane liner reduces infiltration sufficiently to prevent migration of PCBs to the ground water. Consistent with Table 4-2, a deed notice, fence, and periodic ground water monitoring would also be recommended.

SITE NAME: Pepper's Steel and Alloys, Florida.

SITE DESCRIPTION: The site occupies 30-acres in Medley, Florida, approximately 10 miles northwest of Miami overlying the Biscayne Aquifer. This aquifer is used as a sole source drinking water supply for a large population. This location has been the site of a variety of businesses including the manufacture of batteries and fiberglass boats, repair of trucks and heavy equipment and an automobile scrap operation. Batteries, underground storage tanks, transformers, discarded oil tanks and other miscellaneous debris have accumulated as a result of disposal from past and present operations at the site. Contaminants have been identified within the soil, sediments and ground water.

WASTE DESCRIPTION: The contaminants of concern are polychlorinated biphenyls (PCBs), organic compounds and metals such as lead, arsenic, cadmium, chromium, copper, manganese, mercury, zinc and antimony. The quantities and concentrations of the primary contaminants are

- PCBs - 48,000 cubic yards of soil at 1.4 ppm to 760 ppm,
  12,000 gallons of free oils with concentrations up to 2,700 ppm;
- Lead - 21,500 cubic yards of soil at 1,100 ppm to 98,000 ppm;
- Arsenic - 9,000 cubic yards of soil at concentrations greater than 5 ppm.

PATHWAYS OF CONCERN: Of significant concern is ground water transport of PCBs and lead to private wells and lead intake due to ingestion from direct contact with local soils. Air particulate matter containing PCBs provides a possible inhalation exposure pathway to onsite workers and offsite to neighboring residents.

TREATMENT TECHNOLOGY SELECTED: The recommended remedial alternative involves the excavation of PCB contaminated soils > 1 ppm and solidifying with a cement-based material followed by onsite placement. Soils contaminated with > 100 ppm lead or > 5 ppm arsenic will be excavated and chemically fixed (stabilized), thus reducing dissolution and diffusion rates. Free oils contaminated with PCBs will be treated offsite at a Toxics Substances Control Act (TSCA) approved incinerator. The offsite disposal of the free oil is cost-effective, implementable and satisfied the disposal requirements of TSCA Part 761.60(a). The solidified mass will be replaced onsite approximately 4-5 feet above ground water level.

EQUIVALENT TREATMENT: TSCA regulation 761.60(a)(4) requires that soils containing PCBs at concentrations greater than 50 ppm be destroyed by incineration or disposed in a chemical waste landfill. TSCA 761.60(e) provides for the approval of alternative methods of disposal which achieve a level of performance equivalent to incineration and protective of human health and the environment. The TSCA Spill Cleanup Policy (Part 761.120) covers spills which occurred since May 4, 1987. Spills which occurred before that date are to be decontaminated to requirements established at the discretion of EPA, usually through its regional offices. TSCA regulation 761.123 defines the relationship of the PCB Spill Cleanup Policy to other statutes. The Policy does not affect cleanup standards or requirements for the reporting of spills imposed, or to be imposed under other Federal statutory authorities including CERCLA. Where more than one requirement applies, the stricter standard must be met. PCB spills at Pepper's Steel took place during a period between 1960 through the early 1980's, therefore the PCB Spill Cleanup Policy is not applicable to this situation.

Incineration was deemed unacceptable due to high metal content in the contaminated soils. The volatilization of the metals would result in significant air discharges even with the implementation of air control mechanisms on the incinerator. Depending on the air control method used, scrubber waters or bag house filters contaminated with metals, and metals in the incinerated ash, would require appropriate disposal. Offsite disposal in a chemical waste landfill was eliminated as an option due to high cost, inhalation risks and concerns of offsite transportation of the material.

The selected remedial action addresses direct contact risk reduction by rendering the PCB matrix immobile through chemical fixation. In addition, the solidified mass will be covered with a 12-inch layer of crushed limestone to further eliminate these threats. Since PCB contaminated soil with concentrations > 1 ppm will be solidified, the action is consistent with the TSCA PCB Spill Cleanup Policy (761.125) which recommends a 10 ppm cleanup level for a site with nonrestricted access.

Of chief concern with the fixation method is the long term integrity of the fixed mass related to near surface ground water or infiltrating rainwater which may contribute to migration of the contaminants. To assess risk of injury to health or the environment, the EPA performed treatability studies on the solid mix to define performance standards. The tests performed to verify the integrity of the solidified matrix were Toxic Characteristic Leaching Procedure (TCLP), Extraction Procedure (EP) Toxicity, ANS 16-1 and a modified MCC-11. Fate and modeling (method not provided) were used to establish ground water action levels to monitor for failure of the technology. This remedial action warrants the submission of a waiver under 40 CFR 761.75(a)(4) for chemical waste landfills. Under this regulation the EPA Administrator may waive certain landfill requirements if it is determined that the landfill does not present an unreasonable risk of injury or adverse effects to health or the environment. This alternative satisfactorily addresses specific concerns in TSCA chemical waste landfill requirements by providing leachate collection, monitoring wells and a liner or fill to maintain the solidified mass above the ground water table.

Parameters for the treatability studies were set using the Water Quality Criteria Standard of 0.079 ng/l PCBs in water for PCBs at the property line several hundred feet from the solidified mass. Using ground water modeling, a level of 7 ppb PCB in leachate from the solidified mass was established as the maximum allowable concentration which would yield an acceptable risk at the receptor. Results from the treatability studies all indicated concentrations of PCBs in leachate of less than the detectable limit of 1 ppb.

This remedial action can be viewed to be consistent with two areas of TSCA PCB disposal policies. The solidification of the waste and leachate monitoring provide additional protective measures than are required in the chemical waste landfill regulations. The action also achieves a level of performance equivalent to incineration. Analysis of leachate from the solidified mass shows no PCBs at a detection limit of 1ppb, which supports the conclusion that the mobility of PCBs into the surrounding environment is essentially destroyed.

SITE NAME: Wide Beach, NY

SITE DESCRIPTION: The Wide Beach Development site is located in a small lakeside community in Brant, New York, approximately 48 km south of Buffalo. The Development covers 22 hectares, 16 of which are developed for residential use. The site is bordered on the west by Lake Erie, on the south by wetlands and on the east and north by residential and agricultural property. Between 1968 and 1987, 155 cubic meters (approximately 744 barrels) of waste oil, some containing polychlorinated biphenyls (PCBs), was applied to roadways for dust control by the Wide Beach Homeowners Association. In 1980, the installation of a sewer line resulted in excavation of highly contaminated soils and surplus soil was then used to fill in several yards and a nearby grove of trees.

The Erie County Department of Environmental Planning investigated a complaint in 1981 of odors coming from nearby woods. They discovered 19 drums in the woods and two contained PCB-contaminated waste oil. Alerted to a potential problem subsequent investigatory sampling revealed the presence of PCBs in dust, soil, vacuum cleaner dust, and water samples from private wells.

In 1985 the EPA performed an action to protect the public from the immediate concern until implementation of a long-term measure. The action involved the paving of roadways and drainage ditches, decontamination of homes by rug shampooing, vacuuming, and replacement of air conditioner and furnace filters and protection of individual private wells by installation of particulate filters.

WASTE DESCRIPTION: The primary containment at the Wide Beach site is PCBs, found over the majority of the site in all environmental media. The most significant contaminations were found in the sewer trench wells, soils adjacent to the roadways and wetlands sediments. Maximum PCB concentrations from the following areas were:

- drainage ditch samples - 1,026 ppm;
- yards and open lot samples - 600 ppm;
- unpaved driveway samples - 390 ppm;
- roadway samples - 226 ppm;
- sediment samples from marsh area - 126 ppm

The concentration of PCBs in one catch basin sample was 5,300 ppm. Investigations revealed that one of eight monitoring wells, and all six sewer trench wells were contaminated with PCBs. Drinking water sampling studies discovered PCB contamination in 21 of 60 residential wells, however, the level of contamination was low ranging from 0.06 ug/l to 4.56 ug/l.

PATHWAYS OF CONCERN: The primary pathway of concern is through the ingestion of PCB contaminated soils. Additional potential concerns involve the environmental impact of contamination on the surrounding marshlands.

TREATMENT TECHNOLOGY SELECTED: The recommended remedial alternative involves the excavation of contaminated soils > 10 ppm PCBs, onsite chemical treatment to destroy PCBs and soil residual replacement. The recommended treatment will involve removing 5,600 cubic meters of soil from the roadway, 8,500 cubic meters from drainage ditches, 1,500 cubic meters from unpaved driveways and 13,000 cubic meters from back and front yards. The chemical treatment for the 28,600 cubic yards of contaminated soil consists of a two step procedure. First, PCB molecules are extracted from the soils using solvents. The solvents are then treated with Potassium Polyethylene Glycol (KPEG), to remove chlorine atoms from the PCB molecule. This slurry is then pumped to a jacketed, internally agitated, batch reactor where the mixture is maintained at a soil moisture content of 2-3 percent for two hours at a temperature of 140 degrees Celsius while the dechlorination reaction takes place. This stage is followed by several water washes, and solids separation. The soils will be replaced onsite after the PCB contaminated matrix is treated to 2 ppm.

<u>EQUIVALENT TREATMENT</u>: TSCA regulation 761.60(a)(4) requires that soils containing PCBs at concentrations greater than 50 ppm be destroyed by incineration or disposed in a chemical waste landfill. TSCA 761.60(e) provides for the approval of alternative methods of disposal which achieve a level of performance equivalent to incineration and are protective of human health and the environment. Incineration was rejected as a remedial alternative option during the remedial investigation and was not documented in the Record of Decision. Offsite landfilling of the PCB soils was rejected due to concerns of excessive cost, dust release during excavation and possible exposure risks during transport.

Primary concerns with this treatment technology include the ability to attain the 10 ppm level for soil decontamination, and the potential formation of toxic end products through use of the reaction vessel. To address these concerns pilot plant treatability studies were performed to assess the effectiveness of potassium polyethylene glycol in dechlorinating the PCBs, and to determine important design parameters for the reaction vessel such as physical dimensions, operation temperatures and detention time. The results from one run revealed a reduction from 260 ppm in soil to under 2 ppm in the treated residual. Runs were performed on soil at 80 ppm PCBs which is the average concentration at the site. The results indicated that the 10 ppm PCB levels could be achieved consistently. Lab tests in the bench scale treatability study revealed no mutagenic effects with the soil, indicating that the residuals are non-toxic. The results of both KPEG bench scale and pilot plant treatability studies showed that PCB concentrations of 10 ppm or lower can be achieved successfully without hazardous end products, which eliminates the primary concerns with this treatment.

The 2 ppm cleanup level was derived by Best Demonstrated Available Technology (BDAT) values, TSCA policy, and health-based criteria identified in the risk assessment. The TSCA policy for evaluating whether treatment is equivalent to incineration (TSCA 761.60(e)) defines successful equivalent treatment by the level of PCBs in the treatment residual. A concentration of 2 ppm is considered to indicate the treatment has achieved a level of performance equivalent to incineration. The selected treatment destroys PCBs in contaminated soils therefore eliminating the potential risk identified in the risk assessment (i.e., direct contact threats). KPEG also provides protection through permanent and significant reduction of toxicity, mobility and volume of the waste, and complies with all relevant and appropriate requirements set forth in TSCA. Since this method has achieved a level of performance equivalent to incineration through pilot studies and it has been shown to be protective of human health and the environment, it is an acceptable alternative to incineration.

APPENDIX C

DETERMINING APPROPRIATE LONG-TERM MANAGEMENT CONTROLS

DETAILED CALCULATIONS FOR CASE STUDY

Introduction

To illustrate the process of determining the appropriate long-term management controls for low-threat PCB contamination that will remain at a site, an example analysis is provided. Several source concentrations are evaluated.

The evaluation presented in this Appendix concentrates on ensuring that PCBs remaining will not adversely affect the quality of the ground water. Where concentrations remaining on site are higher than levels determined to be safe for direct contact, measures to prevent or limit access to the contaminated areas should be instituted. For concentrations within an order of magnitude of the health-based level, a soil or cement cover with a deed notice may be sufficient. Higher concentrations will require fencing and management of the cover over time.

The process used in this assessment involved two primary steps:

1. Evaluation of potential cap designs and their impact on infiltration through the contaminated zone.

2. Evaluation of the migration of PCBs to and into the ground water.

Once this was completed the concentrations of PCBs in the ground water was compared to the drinking water standard, .5 ppb, to identify the cap which prevented infiltration to the extent necessary to prevent degradation of the ground water.

This first section of this appendix provides a description of the site including the values of parameters necessary for the evaluation of PCB migration. Next the cap designs considered are presented with the description of the analysis of the infiltration expected. Finally, the model which estimates PCB migration to ground water is described and the resulting ground water concentrations for the various scenarios considered is presented.

Description of Site and Variations

The description of the site focusses on the factors that would affect the migration of PCBs and consequently indicate a need for a different level of control. These include:

- Size of PCB source area -- area and depth
- Concentration of PCBs
- PCB biodegradation rate

- Depth to ground water and thickness of saturated zone of interest

- Flow of ground water

- Rate of infiltration through the contaminated zone

- Soil porosity

- Organic carbon content of soil

- Bulk density of soil

The values of these factors used in the scenario evaluated in this example are discussed below.

Size of Site The site evaluated in this analysis covers 5 acres and the contamination is assumed to extend 10 feet vertically.

Concentration of PCBs PCB concentrations are assumed to be the same throughout the contaminated zone. Concentrations of 5, 20, 50 and 100 ppm were evaluated to provide examples where long term management controls short of the minimum technology requirements under RCRA and the chemical waste landfill requirements under TSCA can usually be justified. (As shown in Table 3-4, in the unusual case where PCBs at concentrations exceeding 500 ppm are left on site, minimum technology requirements are generally warranted.)

PCB Biodegradation Rate Since the model evaluates PCB migration over very long time frames (up to 10,000 years) it seemed appropriate to incorporate some estimate of PCB biodegradation. Several studies have documented highly variable PCB biodegradation rates (Quensen, 1988; Bedard, 1986; Brown, 1987). A half life of 50 years was assumed in this analysis.

Depth to Ground Water/Thickness of Saturated Zone The ground water table is encountered at 20 feet below the surface. A saturated thickness of 5 feet was assumed since this represents a conservative minimum screened interval for a well.

Flow of Ground Water The ground water is flowing at 310 feet per year. This is a typical flow for a sand and gravel aquifer and would be sufficient to provide 150 gallons per day with a 60-foot wide capture zone from a well screened over the first five feet. This is the minimum amount of water assumed to be used by a family of four. This reflects a very conservative scenario since few wells are screened through a thickness of only 5 feet. In most cases, wider intervals would be screend and greater dilution of PCBs would occur.

Rate of Infiltration Through the Saturated Zone The infiltration values used in this analysis were developed using the Hydrologic

Evaluation of Landfill Performance (HELP): version II, computer program (U.S. EPA, 1984). This program was used to estimate runoff, evapotranspiration, and infiltration rates through the four cap designs considered. Climatic conditions of the City of Seattle, Washington, were used to model rainfall, temperature, and other daily climatological data. Seattle was picked after preliminary estimates showed that the combination of climatic conditions in that city was one of the most extreme of all U.S. climates and would therefore represent a conservative scenario. A more detailed description of the use of the HELP model is presented below.

Soil Porosity The porosity of the soil was assumed to be 25% which corresponds to a mixed sand and gravel (Fetter, 1980).

Organic Carbon Content of Soil The first 10 feet of soil was assumed to have an organic content of 5%. The 10 feet below that was assumed to have an organic content of .5%. The organic content of the soil in the saturated zone was assumed to be .1%. This is a farely typical range.

Bulk Density of Soil A bulk density of 1.97 g/ml was used based on the porosity of .25 and the density of quartz, 2.63 g/ml.

Cap Designs/Infiltration Evaluation

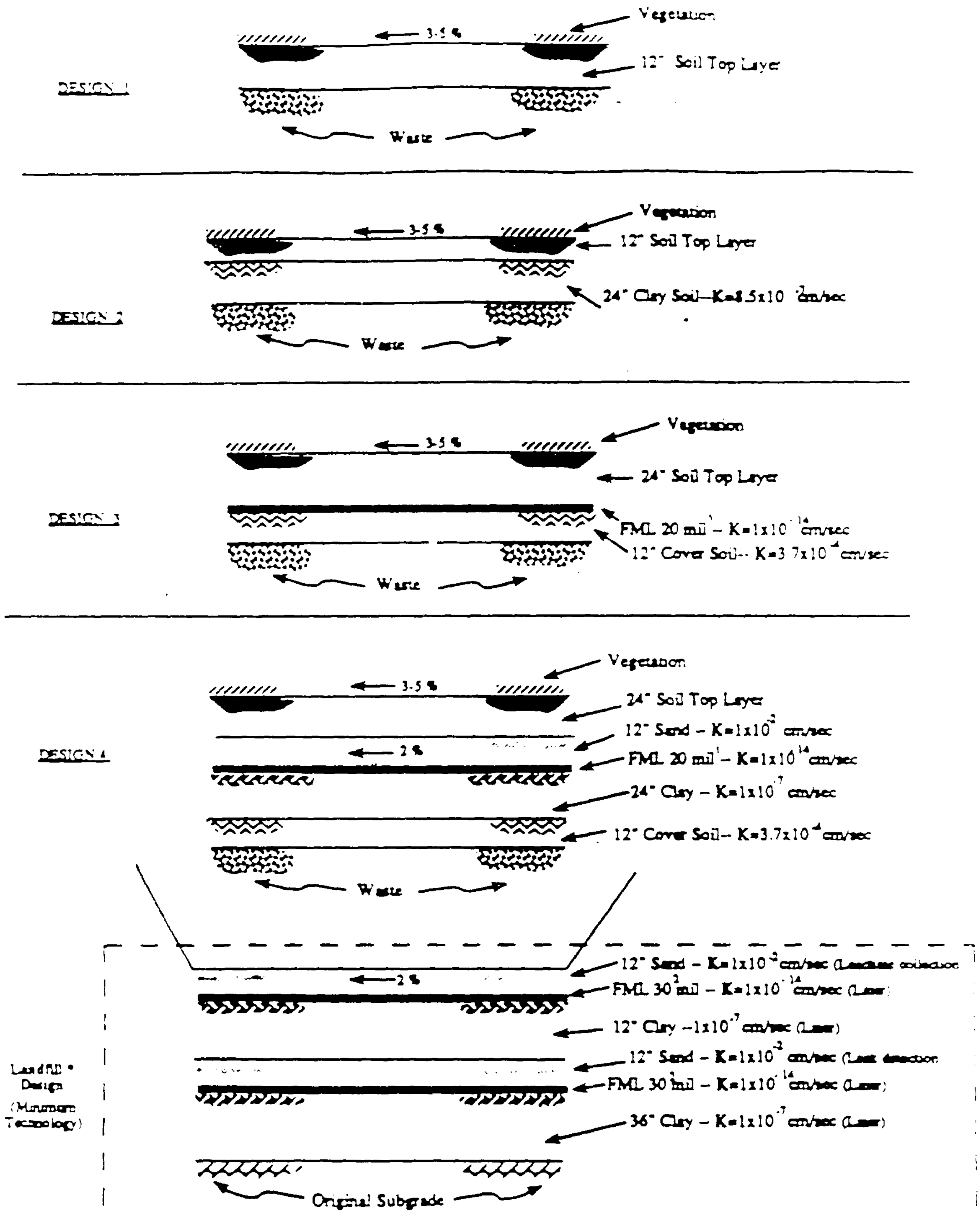
Four different cover systems were considered. These are shown in Figure C-1. As indicated cover system 1 is simply a 12 inch soil cap, cover system 4 reflects the RCRA cover design guidance (U.S. EPA, 1989d), and cover systems 2 and 3 reflect intermediate cover systems. Given the fact that climatological conditions are the same for all alternatives and that soil properties do not change, the only variables are the number of layers, their type, and their thicknesses. Brief descriptions of the physical properties of each layer used in the design models are presented below:

Vegetative soil layer This layer consists of sandy loam. The permeability of this soil is approximately 1 X 10^{-3} cm/sec. This permeability is considered moderate-to-high when compared to other soils.

Sand drainage layer This layer consists of clean, coarse sand. The permeability of this sand is approximately 1 X 10^{-2} cm/sec. This sand is considered a highly permeable soil.

Synthetic drainage layer (geonet) This layer is typically made of two high density polyethylene (HDPE) strands bonded together in a crossing pattern. Geonets are called geocomposites when they are sandwiched between two layers of geotextile fabric. Geonets and geocomposites are typically characterized by their transmissivities. The transmissivity of a layer equals the

Figure C-1
Cap Design Details



* RCRA Minimum Technology Landfill bottom liner design for remedial actions requiring RCRA landfill construction

permeability of that layer multiplied by its thickness. Therefore, the permeability of a geonet can be calculated by dividing its transmissivity by its thickness. A transmissivity of 5×10^{-4} m^2/sec is assumed for a 1/4-inch-thick geonet, corresponding to a permeability of 7.8 cm/sec. This permeability is considered extremely high when compared to permeabilities of soil classes.

Compacted clay barrier layer This layer consists of mechanically compacted clay. The permeability of this layer is approximately 1×10^{-7} cm/sec. This clay is considered a highly impermeable soil.

Synthetic barrier layer This layer consists of a flexible synthetic membrane (FML). Typically, FMLs are considered impermeable. Thus, their effectiveness is measured by estimating the number and size of holes or defects that would be expected from manufacturing or installation operations. It is believed, for the purposes of comparison, that the permeability of this layer is approximately equivalent to 1×10^{-14} cm/sec. This permeability is considerably lower than the permeabilities of soil classes. However, in the HELP-II model this layer is considered impermeable and a leakage fraction, corresponding to the number and sizes of holes, is used to estimate the inflow rate through this layer.

Cover soil layer This layer consists of firm sandy clay loam. Its permeability is approximately 1×10^{-4} cm/sec. This permeability is considered moderate, when compared to permeabilities of other soils.

The Hydrologic Evaluation of Landfill Performance (HELP); version II, computer program (U.S. EPA, 1984) is a quasi-two-dimensional hydrologic model of water movement that was developed by the U.S. Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi, for the EPA Hazardous Waste Engineering Research Laboratory, Cincinnati, Ohio. Help-II models water movement across, into, through, and out of landfills. It uses climatological, soil, and landfill design data. The model accounts for the effects of runoff, surface storage, evapotranspiration, soil moisture storage, lateral drainage, hydraulic head on barrier layers, infiltration through covers, and percolation from liners. The model does not account for lateral inflow of ground water or surface water runon, nor does it account for surface slopes of the cover for runoff. The program reports peak daily, average monthly, and average annuual water budgets. The HELP-II model, which is currently being recommended by EPA for estimating infiltration through cover systems, has readily available climatological data for 102 U.S. cities, including Seattle, Washington. The climatological data consists of daily precipitation values from 1974 through 1978. Other daily climatological data are stochastically generated using a model developed by the Agricultural Research Service

(Richardson, 1984).

The soil and cover design data are entered either manually or by selecting default soil characteristics. Each landfill was assumed to have the following design characteristics:

1. SCS RCN, 69; this value corresponds to a runoff curve number, under average antecedent moisture conditions, for a fairly grassed soil that has a moderate infiltration rate.

2. Drainage media slope, 2 percent; this value represents the minimum cover slope allowed by RCRA minimum technology guidance; it has very little effect on the HELP model when under 20 percent.

3. Drainage length (spacing between collectors), 500 feet; this value was selected because RCRA does not require collection pipes in the cover system and therefore, it is unlikely to find any collectors on the cover.

Table C-1 summarizes the pertinent values for the four cap designs considered in this analysis. The infiltration value indicated is the value used for the infiltration entering the contaminated zone in the calculation of PCB migration to the water table.

PCB Migration To Ground Water

The PCB attenuation analysis was performed using EPA's one-dimensional unsaturated zone finite-element flow and transport: module, VADOFT (U.S. EPA, 1989g), coupled to the analytical solute/heat transport AT123D (Yeh, 1981). The finite-element module was used to evaluate vertical PCB transport in the unsaturated zone and to generate time varying mass flux rates at the water table which were used as input to AT123D which was used to simulate mass transport in the saturated zone (Figure C-2). AT123D was used to determine a time series of depth averaged concentrations beneath the PCB source. The results were then time averaged over the seventy-year period representing the years of peak concentrations occurring within a 10,000-year period.

VADOFT is a one-dimensional, non-linear, finite-element code used to evaluate variably saturated groundwater flow and solute transport. Solute transport in the unsaturated zone is described by the following governing equation:

$$\phi_v S_w R_v (dC/dt) = D_v (d^2C/dZ^2) - V_v (dC/dZ) - {}_{v}\phi_v S_w R_v C \qquad (1)$$

where: ϕ_v = the effective porosity
S_w = the saturation
V_v = the vertical Darcy velocity
${}_{v}$ = the decay coefficient

Table C-1 COVER DESIGN SUMMARY TABLE (ANNUAL VALUES)					
Cover Design	Site Area (Acres)	Precip. (Cu.Ft.)	Runoff (Cu. Ft.)	Evapotrans. (Cu. Ft.)	Infiltration (Cu. Ft.)/ Acre
1	2	258,877	3,349	113,134	71,467
2	2	285,877	78,164	114,628	33,529
3	2	258,877	127,318	131,170	226
4	2	285,877	94,262	118,162	1

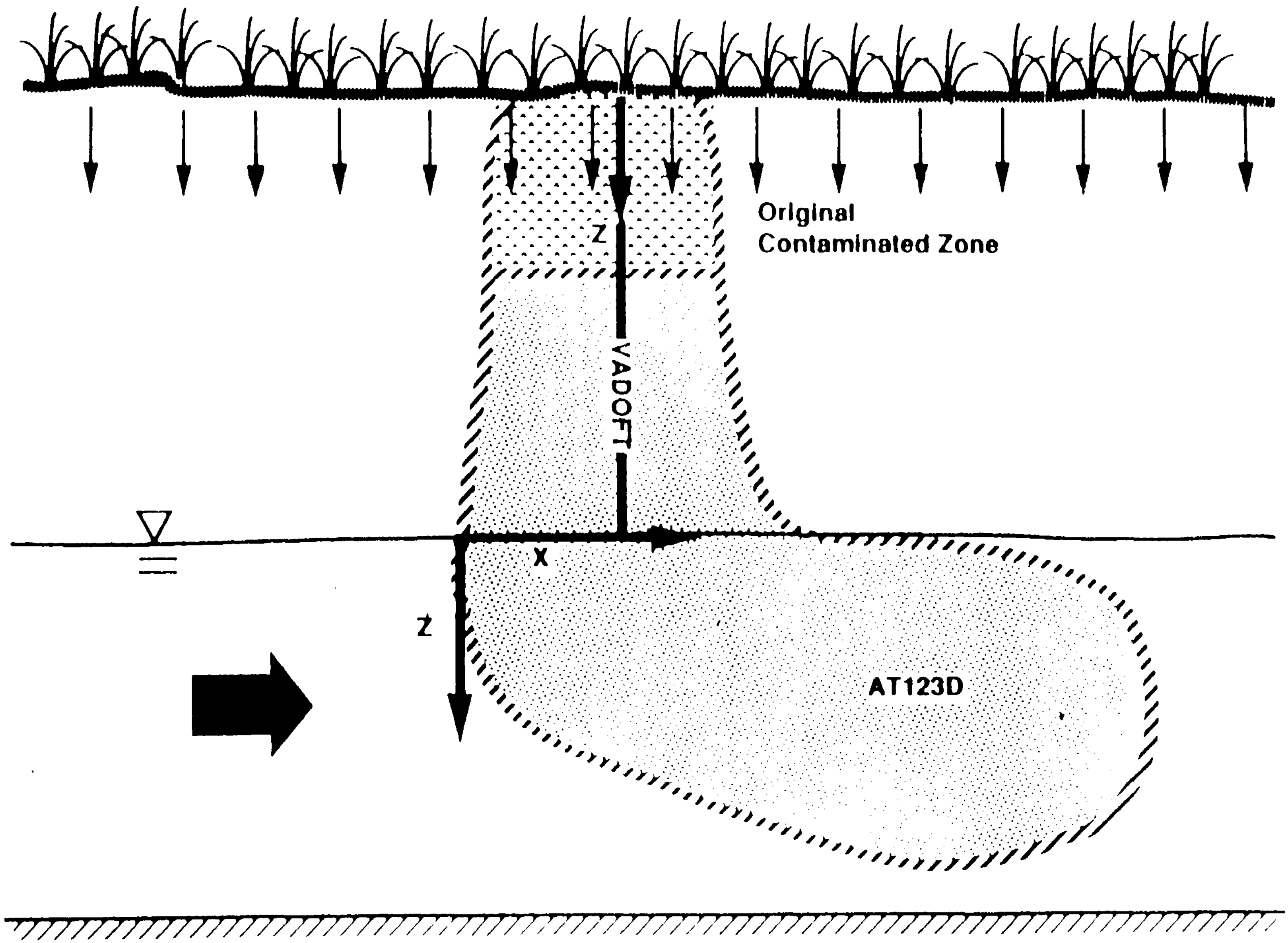


FIGURE C-2 EVALUATION AREAS FOR VADOFT AND AT123D

$R_v = 1 - ((K_d p_b)/(o_v S_w))$ = the retardation coefficient (2)
K_d = the adsorption coefficient
and
p_b = the bulk density of the soil

For transport simulations using a steady-state flow field and where there is no decay, or the decay rate is not a function of the saturation, the nonlinear flow analysis may be avoided for highly adsorptive chemicals. For chemicals with large adsorption coefficients (e.g., greater than 10) such as PCB's:

$$R_v \quad (K_d p_b)/(o_v S_w) \qquad (3)$$

and the saturation terms in Equations (1) and (2) cancel and can be disregarded. This circumvents the need for the nonlinear flow analysis and allows the transport analysis to be performed using a default Darcy velocity equal to the infiltration rate. Transient finite-element solute transport analyses were performed for the period of interest to generate time series of mass flux rates that were used as a boundary condition for AT123D.

AT123D, an analytical method based on Green's function techniques, simulates three-dimensional advective/dispersive transport in porous media. The three-dimensional solute transport equation on which AT123D is based can be written as:

$$D_x(d^2C/dx^2) + D_y(d^2C/dy^2) + D_z(d^2C/dz^2) - V_s(dC/dx) =$$

$$R_s(dC/dt) + R_s \; {}_sC + ((qC)/(Bo_s)) + M/o_s \qquad (4)$$

where: x, y, z = spatial coordinates in the longitudinal, lateral and vertical directions, respectively
C = dissolved concentration of chemical
D_x, D_y, D_z = dispersion coefficients in the x, y, and z directions, respectively
V_s = one-dimensional, uniform seepage velocity in the x direction
R_s = retardation factor in the saturated zone
t = elapsed time
$_s$ = effective first-order decay coefficient in the saturated zone
q = net recharge outside the facility percolating directly into and diluting the contaminant plume
B = the thickness of the saturated zone
M = the constant or time dependent mass flux rate

By taking the products of various directionally independent spatially integrated Greens functions the model allows for the application of linear, planar and volumetric mass flux sources to a porous medium which is of infinite extent in the flow direction and can be considered to be of either infinite or finite extent in the directions perpendicular to flow. Temporally, the Greens functions represent instantaneous sources which are numerically integrated with respect to time to allow for a constant mass flux or a time variant mass flux source condition. The general

solution can be written as follows:

$$C(x,y,z,t) = (M/(o_s R_s)) F_{ijk}(x,y,z,t;) d \qquad (5)$$

where: t = time of interest
= variable of integration

The term F_{ijk} is the product of the three-directionally-independent Greens functions (Yeh, 1981). Since the source term is a mass flux rate, a decay term accounting for dilution due to infiltration of water was utilized. This dilution factor is shown in the second to last term of Equation (4). For these simulations the source was approximated as a fully penetrating rectangular prismatic source with a surface area equal to the source area. The fully penetrating source was used to circumvent the need to depth average values of the concentrations.

RESULTS

The results of the analysis described above are summarized in table C-2. PCB concentrations in ground water were estimated for each of the four cap designs and four different PCB source concentrations. Based on this analysis, the following recommendations for caps could be made:

5 ppm PCBs Source At this concentration the threat of PCB migration to ground water at concentrations that would exceed the proposed MCL of .5 ppb under the given site conditions is unlikely. The maximum concentration averaged over 70 years (occuring after 945 years) is .099 ppb with only a soil cap. The soil cover would be recommended for sites in residential areas to prevent contact with concentrations above 1 ppm, the starting point action level.

20 ppm PCBs Source Again, the analysis indicates that the threat to ground water is not significant. With only a soil cap, the maximum concentration expected is .4 ppb. For sites in residential areas, a cement cover and a deed notice may be warranted to prevent contact with PCBs exceeding the 1 ppm starting point action level.

50 ppm PCBs Source At 50 ppm, PCB concentrations in the ground water are projected to exceed the .5 ppb level slightly -- approximately 1 ppb. At this concentration, for the site conditions presented, the second cap illustrated in Figure C-1 would be recommended. The combination of a low-permeability cover

Table C-2 SATURATED ZONE DEPTH AND TIME AVERAGED CONCENTRATIONS BENEATH THE SOURCE (PPB) AND TIME OF PEAK CONCENTRATION (YEARS)																			
Soil Concentration 5 ppm				Soil Concentration 20 ppm				Soil Concentration 50 ppm				Soil Concentration 100 ppm				T_{Peak} (Years)			
Cap Design 1	Cap Design 2	Cap Design 3	Cap Design 4	Cap Design 1	Cap Design 2	Cap Design 3	Cap Design 4	Cap Design 1	Cap Design 2	Cap Design 3	Cap Design 4	Cap Design 1	Cap Design 2	Cap Design 3	Cap Design 4	Cap Design 1	Cap Design 2	Cap Design 3	Cap Design 4
099	029	0.0	0.0	396	114	0.0	0.0	990	290	0.0	0.0	1.98	580	0.0	0.0	945	1645		

SITE PARAMETERS
Source Area: 5 Acres Average Regional Flow: 310 ft/year Porosity of Soil: 0.25 Bulk Density of Soil: 1.97 g/ml Time: Peak 70 years from 0-10,000 years Contaminated zone organic content: 5.0% Clean unsaturated zone organic content: 0.1% Saturated zone organic content: 0.1% PCB half life: 50 years Depth of Contamination: 10 feet Depth to Groundwater: 30 feet Thickness of Saturated Zone: 5 feet

APPENDIX E

PCB DISPOSAL COMPANIES, COMMERCIALLY PERMITTED

NOV 29 1989

PCB DISPOSAL COMPANIES
COMMERCIALLY PERMITTED

* Permitted to operate in all ten EPA Regions

COMPANY	ADDRESS	PHONE No.	
INCINERATOR			
ENSCO	P.O. Box 1957 El Dorado, AR 71730	501-223-4160	
ENSCO	P.O. Box 8513 Little Rock, AR 72215-8513	501-223-4100	*
General Electric	100 Woodlawn Ave. Pittsfield, MA 01201	413-494-3729	
Pyrochem/Aptus	P.O. Box 907 Coffeyville, KS	316-251-6380	
Rollins	P.O. Box 609 Deer Park, TX 77536	713-479-6001	
SCA Chemical Services	11700 South Stony Island Ave. Chicago, IL 60617	312-646-5700	
U.S. Department of Energy/ Martin Marietta Energy Systems	Federal Office Building Room G-108 P.O. Box E Oak Ridge, TN 37830	615-576-0973	
WESTON	One Weston Way West Chester, PA 19380	215-692-3030	*
ALTERNATE THERMAL			
Ecova Corporation	12790 Merit Drive Suite 220, Lock Box 145 Dallas, Texas 75251	214-404-7540	*
Ogden Environmental Services, Inc. (formerly GA Technologies, Inc.)	P.O. Box 85178 San Diego, CA 92138-5178	800-876-4336 or 619-455-3045	*
J.M. Huber Corporation	P.O. Box 2831 Borger, TX 79007	806-274-6331	
O.H. Materials Corporation	16406 U.S. Route 224 East P.O. Box 551 Findlay, Ohio 45839-0551	800-537-9540	*

CHEMICAL

American Mobile Oil Purification Co.	233 Broadway, 17th Floor New York, NY 10279	212-267-7073	*
Chemical Waste Management	1550 Balmer Road Model City, NY 14107	716-754-8231	
Exceltech, Inc.	41638 Christy Street Fremont, CA 94538	415-659-0404	
General Electric	One River Road Schenectady, NY 12345	518-385-3134	
General Electric	One River Road Schenectady, NY 12345	518-385-3134	*
National Oil Processing/Aptus	P.O. Box 1062 Coffeyville, KS 67337	800-345-6573	
Niagara Mohawk Power Corporation	300 Erie Boulevard West Syracuse, NY 13202	315-474-1511	
PPM, Inc.	1875 Forge Street Tucker, GA 30084	404-934-0900	*
ENSR Operations (formerly Sunohio)	1700 Gateway Blvd. S.E. Canton, OH 44707	216-452-0837	*
T & R Electric Supply Company, Inc.	Box 180 Colman, SD 57017	800-843-7994	
Transformer Consultants	P.O. Box 4724 Akron, OH 44310	800-321-9580	*
Trinity Chemical Co. Inc.	6405 Metcalf, Cloverleaf 3 Suite 313 Shawnee Mission, KS 66202	913-831-2290	

PHYSICAL SEPARATION

ENSCO	1015 Louisiana Street Little Rock, AR 72202	501-223-4100	*
National Electric/ Aptus	P.O. Box 935 Coffeyville, KS 67337	800-345-6573	
Quadrex HPS, Inc.	1940 N.W. 67th Place Gainesville, FL 32606	904-373-6066	*
Unison Transformer Services, Inc.	P.O. Box 1076 Henderson, KY 42420	800-544-0030	

PHYSICAL SEPARATION continued

General Electric	One River Road Schenectady, NY 12345	518-385-3134

PCB TRANSFORMER DECOMMISSIONING

G&L Recovery Systems, Inc.	1302 West 38th Street Ashtabula, Ohio 44004	216-992-8665

BIOLOGICAL

Detox Industries, Inc.	12919 Dairy Ashford Sugar Land, TX 77478	713-240-0892

PIPELINE REMOVAL

Texas Eastern Gas Pipeline Company	P.O. Box 2521 Houston, Texas 77252-2521	713-759-5167

CHEMICAL WASTE LANDFILLS

Casmalia Resources	559 San Ysidro Road P.O. Box 5275 Santa Barbara, CA 93150	805-937-8449
CECOS International	56th St. & Niagara Falls Boulevard Niagara Falls, NY 14302	716-282-2676
CECOS International	5092 Aber Road Williamsburg, OH 45176	513-720-6114
Chemical Waste Management	Alabama Inc. Box 55 Emelle, AL 35459	205-652-9721
Chemical Waste Management	Box 471 Kettleman City, CA 93239	209-386-9711
Chem-Security Systems Incorporated	Star Route Arlington, OR 98712	503-454-2777
Envirosafe Services Inc. of Idaho	P.O. Box 417 Boise, ID 83701	208-384-1500
SCA Chemical Services	Box 200 Model City, NY 14107	716-754-8231

CHEMICAL WASTE LANDFILLS continued

U.S. Ecology, Inc.	Box 578 Beatty, NV 89003	702-553-2203
U.S. Pollution Control, Inc.	Grayback Mountain Knolls, UT 84074	435-528-8371

U.S. EPA REGIONAL DISPOSAL CONTACTS

Region I

(Connecticut, Maine, Massachusetts
Rhode Island, Vermont)

Tony Palermo
Air Management Division
Environmental Protection Agency, Region I
John F. Kennedy Federal Building
Boston, Massachusetts 02203
(617) 565-3279, FTS 835-3279

Region II

(New Jersey, New York, Puerto Rico, Virgin Islands)

John Brogard
Air and Waste Management Division
Environmental Protection Agency, Region II
26 Federal Plaza
New York, New York 10278
(212) 264-8682, FTS 264-8682

Dan Kraft
FTS 340-6669

Region III

(Delaware, District of Columbia, Maryland,
Pennsylvania, Virginia, West Virginia)

Edward Cohen (3HW40)
Hazardous Waste Management Division
Environmental Protection Agency, Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107
(215) 597-7668, FTS 597-7668

Region IV

(Alabama, Florida, Georgia, Kentucky, Mississippi,
North Carolina, South Carolina, Tennessee)

Robert Stryker, PCB Coordinator
Pesticides and Toxic Substances Branch
Environmental Protection Agency, Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365
(404) 347-3864, FTS 257-3864

Region V
(Illinois, Indiana, Michigan, Minnesota, Ohio, [illegible])

[illegible]
Pesticides and Toxic Substances Branch   5S-PTSB-[illegible]
Environmental Protection Agency, Region V
230 South Dearborn Street
Chicago, Illinois 60604
(312) 353-1428, FTS 886-6087

Region VI
(Arkansas, Louisiana, New Mexico, Oklahoma, Texas)

Jim Sales
Hazardous Waste Management Division
Environmental Protection Agency, Region VI
Allied Bank Tower
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 655-6719, FTS 255-6785

Donna Mullins
FTS 255-7244

Region VII
(Iowa, Kansas, Missouri, Nebraska)

Leo Alderman, PCB Coordinator
Doug Elders
Toxic and Pesticides Branch
Environmental Protection Agency, Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101
(913) 236-2835, FTS 757-2835

Region VIII
(Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming)

Dan Bench (303) 293-1732, FTS 330-1732
Tom Pauling (303) 293-1747, FTS 330-1747
Paul Grimm (303) 293-1443, FTS 330-1443   -294-1157
Toxic Substances Branch
Environmental Protection Agency, Region VIII
One Denver Place
999 18th Street, Suite 1300
Denver, Colorado 80202-2413
(303) 293-1442, FTS 564-1442

Region IX

(Arizona, California, Hawaii, Nevada, American Samoa, Guam)

[illegible] (T-3-1)
Pesticides and Toxics Branch
Environmental Protection Agency, Region IX
215 Fremont Street
San Francisco, California 94105
(415) 974-7295, FTS 454-7295

Region X

(Alaska, Idaho, Oregon, Washington)

Cathy Massimino (HW-114)
Hazardous Waste Management Branch
Environmental Protection Agency, Region X
1200 Sixth Avenue
Seattle, Washington 98101
(206) 442-4153, FTS 399-4153

Bill Hedgebeth
FTS 399-7369

APPENDIX F

LONG TERM MANAGEMENT CONTROLS AT PCB-CONTAMINATED SITES

SUPERFUND EXAMPLES

POTENTIAL ARARS:

RCRA: 40 CFR Part 264.310 or 265.301 provides five criteria for the design and constru minimization of liquids; (2) function with minimum maintenance; (3) promote dra and (5) the permeability of the cap must be less than or equal to the permeabil

TSCA: None.

	Vegetative Top Cover					Middle Dr		
Design Summary	Vegetation	Top Slope	Top Soil Thickness	Soil Thickness	Soil Permeability (cm/sec)	Geotextile Filter	Drainage Material	D
A: minimum hnology Guidance	Minimize erosion	At least 3% but no greater than 5%	Total Thickness 24"		N/A	Yes (design to prevent clogging)	Sand or equivalent geosynthetic	
malia Resources ta Barbara, CA								
S International gara Falls, NY	Regional Species		6"		N/A		Geosynthetic	
S International liamsburg, OH	Regional Species		6"	30"	N/A		Geosynthetic	
ical Waste gement le, AL	Regional Species		18"	6"	N/A		N/A PER HELP	
ical Waste gement eman City, CA				24"				
safe Services, daho e, ID	Regional Species		6" 6"	19" 24"	N/A N/A	Yes Yes	Geosynthetic Geosynthetic	
-Security ms, Inc. ngton, OR								
ical Waste gement (SCA) l City, NY	Regional Species		6"	36"	N/A		Sand	
Ecology ty, NV								
Pollution ral, Inc. a, UT								

SUPERFUND EXAMPLES—LONG-TERM MANAGEMENT CONTROLS								
Superfund Site (ROD Date)	Initial Source & Problem	Disposition	Initial PCB Concentration Range (ppm)	Final PCB Concentration (ppm)	Geologic/Hydrogeologic Conditions	Cover Design	Bottom Liners	Leachate Collection/Removal and Leak Detection
1 Ottati and Goss, Kingston, NH (1/16/87)	• Buried drums, sludge	• Excavate • Off site incineration • Cap • Aeration • Extract and treat groundwater	143 (soil)	20 (soil)	• Groundwater: 0-2 feet below surface • Geology: glacial tills, bedrock	9 inches top soil	• None	Groundwater wells planned for pump and treatment
2 Re-Solve, MA North Dartmouth, MA (7/24/87)	• Waste oil spread on dirt roads • Solvent reclamation facility	• Excavate • Cap • On site treatment (dechlorination) • Wetland restoration • Extract and treat groundwater	15-52,000	25 (soil)	• Groundwater: 30-60 feet below surface • Geology: sand, gravel, till, bedrock	Regraded and grassed	• None	Groundwater wells planned for pump and treatment
3 Chemical Control Elizabeth, NJ (9/24/87)	• Variety of waste in drums	• In situ fixation • Debris removal • Storm sewer repair • Secure site (fence)	0.6	0.4	• Groundwater: 1-3 feet below surface • Geology: sand/gravel silty sand, till, bedrock	1-3 foot gravel layer	• None • Natural impermeable clays	None
4 Wide Beach Brant, NY (9/30/85)	• Waste oil spread on dirt roads	• Excavation • Chemical treatment	0.05-1026	10	• Geology: silty sand/gravel, silty/clay, fractured shale	None (not feasible, a residential community)	• None	None
5 York Oil Moira, NY (2/8/88)		• Excavate • Stabilize • Off site incineration • Extract and treat groundwater	1-210		• Groundwater: 30 feet below surface • Geology: glacial bedrock	None (stabilization process leaves treated soils impermeable)	• None • Natural impermeable clays	Groundwater wells planned for pump and treatment
6 Mowbray Engineering ________, AL (9/25/86)	• 3 acre swamp • Transformer repair plant	• Clean sewer • Excavate • Stabilize	ND-42 (soil)	25	• Groundwater: 18 feet below surface • Geology: sandy, clay, rock, limestone	2 feet compacted clay, 2 feet vegetative layer, 2 feet sand, synthetic liner	• None	None
7 Pepper's Steel & Alloys Medley, FL (3/12/86)	• 30 acres trash	• Excavate • Stabilize • Off site incineration • Cap • Extract and treat groundwater	1.5-760 (soil)	1	• Groundwater: 3-6 feet below surface • Geology: fill, peat, limestone	12 inches crushed limestone	• None	Down gradient groundwater wells planned for pump and treatment
8 Belvidere Landfill Belvidere, IL (6/30/88)	• Landfill • Drum Disposal	• Excavate • Off site incineration • Landfill • Cap • Extract and treat groundwater • Secure site	9-51,000	50	• Groundwater: 7 feet below surface • Geology: sand, gravel, bedrock	RCRA cover	• None	Groundwater wells planned for pump and treatment
9 Fort Wayne Fort Wayne, IN (8/26/88)	• Dumping area • Recycling plant	• Excavate • On site incineration • Cap • Containment wall • Extract and treat groundwater • Secure site	0.34-14.2	10	• Groundwater: 10-15 feet below surface • Geology: outwash sands and gravels, lake clays, silts, and fines	2 feet clay and 6 inches vegetative layer	• None	Groundwater wells planned for pump and treatment

(continued)

SUPERFUND EXAMPLES—LONG-TERM MANAGEMENT CONTROLS

Superfund Site (ROD Date)	Initial Source & Problem	Disposition	Initial PCB Concentration Range (ppm)	Final PCB Concentration (ppm)	Geologic/Hydrogeologic Conditions	Cover Design	Bottom Liners	Leachate Collection/Removal and Leak Detection
10 French Limited Crosby, TX (3/24/88)	• 7.3 acre lagoon	• In situ biological treatment • Stabilize	ND-616	23	• Groundwater: less than 50 feet below surface • Geology: topsoil, clay	None	• None • Natural impermeable clay	Groundwater wells may be planned for pump and treatment
11 Commencement Bay/Near Shore Tacoma, WA (12/30/87)	• Scrap yard	• Excavate • Stabilize • Cap • Re-grade	0-204	1	• Groundwater: 0-12 feet below surface • Geology: fill, sand, clay	2 inches sealed asphalt	• None	Groundwater monitoring system proposed
12 Pacific Hide and Fur Pocatello, ID (6/28/88)	• Transformers, capacitors • Scrap yard	• Excavate • Stabilize • Cap		10-25	• Groundwater: 20 feet below surface	Low permeability or RCRA cap	• Low permeability clay added to existing aquitard • Stabilized material to serve as liner	None
13[a] Pinnette's Salvage Yard Washburn, ME (5/3/89)	• Scrap yard • Transformer dielectric fluid spill	• Land Disposal identified as an alternative	7.4-300		• Groundwater: 0-20 feet below surface • Geology: sand and gravel, clay and silty clay, glacial fill, bedrock	4 inches asphalt, 12 inches stone, single synthetic layer; fill	• None	Slurry wall
14[b] Sullivan's Ledge New Bedford, MA (Proposed 1/89)	• Quarry • Previous disposal	• Excavate • Stabilize • Cap • Extract and treat groundwater • Restore wetlands • Secure site • Restrict use • Long-term monitoring	2,400 (soil)		• Groundwater: 100 feet below surface • Geology: quarries located in fractured bedrock	2 feet clay; 10 inches buffer soil, 12 inches sandy soil, 2 feet vegetative soil, vegetation	• None	Groundwater wells may be planned for pump and treatment
15[a] New Bedford Harbor Hot Spot Area Buzzard's Bay, MA (5/89)	• Industrial discharge	• Capping identified as an alternative	500-400 (sediment)		• Groundwater: contamination due to diffusion from sediment	3 feet sand/silt; synthetic layer	• None	None
16[ab] Douglassville Disposal Site Berks County, PA Draft (9/88)	• Oil recycling	• Capping identified as an alternative	ND-30,000 (soils)		• Groundwater: less than 5 feet to 31 feet to surface • Geology: fill, natural over burden bedrock	Synthetic liner; protective soil, topsoil, vegetation	• None	Groundwater barrier
17[ab] Town of Norwood Norfolk County, MA Draft (1/89)	• Electrical equipment manufacturer • Previous disposal	• Capping identified as an alternative	10-36,000 (soils)	10-50	• Geology: fill, sand and gravel, glacial fill, bedrock	3 inches asphalt 2" aggregate; HDPE liner, 6" aggregate geotextile fabric, fill	• None	None

[a] Capping/land disposal identified as an alternative
[b] Proposed Plan